[illegible] Hart

COMMUNICATION DEVELOPMENT IN YOUNG CHILDREN WITH DEAF-BLINDNESS: LITERATURE REVIEW I

Deaf-Blind Communication Skills Center
Teaching Research Division
Oregon State System of Higher Education
Monmouth, Oregon 97361

F-
D

Z5346
B875
C737
1985

B875
C737
1985

COMMUNICATION DEVELOPMENT IN YOUNG CHILDREN WITH DEAF-BLINDNESS: LITERATURE REVIEW I

Edited by Michael Bullis

1985

Deaf-Blind Communication Skills Center
Teaching Research Division
Oregon State System of Higher Education
Monmouth, Oregon 97361

This manuscript was produced under contract #300-83-0237 from the Office of Special Education and Rehabilitation, United States Department of Education. The information presented herein does not necessarily reflect the policy of the Office of Special Education and Rehabilitation and no official endorsement should be inferred.

Digitized by the Internet Archive
in 2013

http://archive.org/details/communicationde00mich

PREFACE

Perhaps no handicapping condition is as debilitating to young children as the dual sensory impairment of deaf-blindness. All too often, children with this type of condition fail to develop even rudimentary communication skills. This situation is further exacerbated by a relative absence of systematic research assessment tools and training curricula expressly designed for persons with deaf-blindness. Fortunately, in recent years, the professional community has directed more attention to this population, and various research endeavors have been initiated to develop materials for use with this population.

One such research project is the Deaf-Blind Communication Skills Center. This project is funded through a five year contract that was awarded in 1983 to the Teaching Research Division of the Oregon State System of Higher Education by the United States Office of Special Education and Rehabilitation. The overall goal of the Center is to develop, implement, evaluate, and disseminate communication interventions that will increase the early communication and language competencies of young children (0-5 years) with deaf-blindness. Toward this end a multi-site, consortium model has been adopted. The Center is administered through Teaching Research and includes: Portland, Oregon, Public Schools; University of Kansas, Department of Special Education; Parsons State Hospital and Training Center, Parsons, Kansas; University of Washington, Experimental Education Unit; University of Wisconsin-Madison, Waisman Center; St. Lukes Hospital, New York, New York; and Utah State University, Exceptional Child Center. At each of these sites specific topics related to communication development in children with deaf-blindness are being investigated. It is our belief that this interlocking network of research efforts is a powerful and efficient approach to the mission of the Center.

This literature review is the first of the products from the Deaf-Blind Communication Skills Center. The intent of this document is to summarize and discuss literature that is relevant to key subject areas in the communication development of the target population. The review is to be published in the second, third, and fourth years of the project; thus, in the following years existing chapters will be revised and other chapters will be added. In this way literature related to the thrust of the project will be updated, progress of investigations at Center sites will be described, and additional subject areas will be covered. It is our hope that this manuscript will be both interesting and helpful to the reader, and that, in some way, it will aid children with deaf-blindness.

Michael Bullis
Project Director
Deaf-Blind Communication Skills Center

SCC80

ACKNOWLEDGEMENT

Kathy Haydon typed the many drafts of this review. Her persistence and attention to detail are greatly appreciated.

CONTRIBUTORS

Pamela Cress
Program Director, Sensory Assessment Projects
Parsons State Hospital & Training Center
Parsons Research Center
Parsons, KS

Douglas Guess
Professor
Department of Special Education Center
University of Kansas
Lawrence, KS

Patty A. Hart
Classroom Teacher
Parsons State Hospital & Training Center
Parsons Research Center
Parsons, KS

Charity M. Rowland
Assistant Research Professor
Teaching Research Division
Oregon State System of Higher Education
Monmouth, OR

Ellin Siegel-Causey
Doctoral Student
Department of Special Education
University of Kansas
Lawrence, KS

Charles R. Spellman
Senior Scientist
Parsons State Hospital & Training Center
Parsons Research Center
Parsons, KS

Joseph E. Spradlin
Senior Scientist
Parsons State Hospital & Training Center
Parsons Research Center
Parsons, KS

Kathleen Stremel-Campbell
Research Professor
Teaching Research Division
Oregon State System of Higher Education
Monmouth, OR

TABLE OF CONTENTS

Page

I. Perspectives on Communication Assessment
Charity M. Rowland 1

II. Tactual/Tactile Assessment
Patty A. Hart and Charles R. Spellman 21

III. Visual Assessment
Pamela J. Cress 31

IV. Auditory Assessment
Joseph E. Spradlin 49

V. Early Development of Prelinquistic Communication
Ellin Siegel-Causey and Douglas Guess 61

VI. Development of Emergent Language
Kathleen Stremel-Campbell 79

I. Perspectives on Communication Assessment

Charity M. Rowland

The assessment of sensory, communicative and cognitive functioning may be extremely difficult in children with vision and hearing impairments, due to motivational problems, limited response repertoires, or the absence of language. Many of the traditional assessment instruments rely upon the subject's ability to comprehend and cooperate with verbal instructions, if not to respond in a verbal mode. This dependence upon receptive and expressive language ability renders these tests useless with nonverbal persons and has led to the labelling of many deaf-blind children as "untestable."

Until recently, vision and hearing assessments for severely disabled children were limited to physiological and electrophysiological techniques that assess only the gross intactness and pathology of the sensory systems. Even these techniques may be inappropriate, however, if the subject demonstrates a lack of cooperativeness or severe seizure disorders. Subjective behavioral techniques requiring nonverbal reponses, some of which utilize operant or classical conditioning procedures, have been developed, but many of these tests require the comprehension of verbal instructions, extensive pretraining or the production of specific fine motor responses. Vision and hearing assessments that provide educationally useful data for young deaf-blind children are only currently being developed. (For a complete discussion of assessment in these areas see Cress, 1985 and Spradlin, 1985 in this document.)

In the domains of cognitive, communicative and social development the standard assessment tools are heavily weighted on the verbal factor and have not been useful for children with vision and hearing impairments. Until a decade ago, the lowest level of socio-communicative development was widely considered to be the absence of language. Children with disabilities were labelled either "verbal" or "nonverbal." The verbal label encompassed a wide range of linguistic skill levels, while the nonverbal label simply indicated a total lack of communicative ability. Presently, communication is viewed as a continuum including a wide spectrum of nonverbal behaviors and non-speech language skills, as well as conventional language. This acknowledgement of the communicative import of nonverbal behaviors has had a positive impact upon the assessment of persons with severe disabilities. In the highly interrelated cognitive and socio-communicative domains, it is now possible to examine the development of generic skills that are demonstrated through either nonverbal or verbal means.

Place Table 1 About Here

Despite the availability of some instruments that can be used to assess children in the target population (see Table 1), a great deal of work remains to be accomplished in the practice of assessment. In fact, the development of useful and psychometrically sound measurement tools is one of the most pressing challenges facing professionals who work with children who are deaf-blind. The purpose of this manuscript is to address

Table 1. Global Assessment Instruments Used with Deaf-Blind Children

Assessment Instrument & Subscales	Age Range	Score Referencing	Target Population	Adapted for Deaf-Blind	Scoring System	Reliability/ Validity Provided
Adaptive Performance Instrument (Consortium on Adaptive Performance Evaluation, 1978). (Gross motor, Fine motor, Self Care, Interaction with objects, Interaction with Adult & Peers, Understanding Communication, Using Communication.)	0-2 yrs.	Criterion	Severely handicapped	Yes	Score & Profile	No
Bayley Scales of Infant Development (Bayley, 1969) (Mental, Motor, Infant Behavior Record).	2-30 mo.	Normed on nondisabled population	Nondisabled	No	Score	Yes
Behavior Rating Instrument for Autistic and other Atypical Children (Ruttenberg et al., 1977) (Relationship, Communication, Sound/Speech Reception, Vocalization/Expressive Speech, Drive for Mastery, Social Responsiveness, Body Movement, Psychobiological Development, Receptive Gestural/Sign Language, Expressive Gestural/Sign Language).	0-4 yrs.	Criterion Normed on autistic population	Autistic	Yes *	Score & Profile	Yes
Callier-Azusa Scale (Stillman 1978) (Motor, Perceptual, Daily Living, Cognition/ Communication/Language, Social)	0-84 mo.	Criterion	Deaf-Blind	Yes	Profile	No
Manual for the Assessment of a "Deaf-Blind" Multiply-Handicapped Child, 3rd Edition (Rudolph & Collins, 1978) (Personal Self-Help, Social, Gross Motor, Fine Motor, Communication, Cognitive, Vision, Audition).	0-6 yr.	Criterion	Deaf-Blind	Yes	Profile	No
McCarthy Scales of Children's Abilities (McCarthy, 1972) (Verbal, Perceptual-Performance, Quantitative, Memory, Motor, General Cognitive).	2.5-8.5 yr.	Normed on nondisabled population	Nondisabled	No	Score	Yes

Table 1. Global Assessment Instruments Used with Deaf-Blind Children, continued

Assessment Instrument & Subscales	Age Range	Score Referencing	Target Population	Adapted for Deaf-Blind	Scoring System	Reliability/ Validity Provided
Portage Guide to Early Education, Revised Edition (Bluma, et al., 1978) (Cognitive, Self-Help, Motor, Language & Socialization, Infant Stimulation)	0-6 yr.	Criterion	Developmentally disabled	No	Profile	No
Wisconsin Behavior Rating Scale (Song, et al., 1980) (Gross Motor, Fine Motor, Expressive Language, Receptive Language, Play, Socialization, Domestic Activity, Eating, Toileting, Dressing, Grooming).	0-3 yr.	Criterion Normed on severely handicapped	Severely handicapped	Yes	Score & Profile	Yes

*Adapted version developed by: Deaf-Blind Communication Activities Project (CAP)
Deafness Research and Training Center
New York University

the general problems of assessing children with vision and hearing impairments, and those of assessing communication- related skills in particular. The paper begins with a discussion of test referencing and the difficulties of using available norm- and criterion-referenced tests with the target population. Next, specific difficulties associated with communication assessment are discussed and suggestions for the construction of a communication assessment instrument specifically for young children with vision and hearing impairments are presented.

General Assessment Issues

Carver (1974) describes the two dimensions along which tests are constructed as "psychometric" and "edumetric." Psychometric tests, such as the standard school aptitude and achievement tests, are designed to reflect stable differences between individuals. This purpose is served best by selecting test items that demonstrate great variability between subjects. For instance, an item that is passed by 50% of the subjects who take the test (i.e., a probability of .50) is the ideal item to distinguish between the performance of two individuals. Psychometric tests are best suited for screening, educational placement, and program evaluation.

Edumetric tests, on the other hand, such as the Brigance Diagnostic Inventory of Basic Skills (Brigance, 1976), are designed to be maximally sensitive to progressive change within individuals on successive administrations. The ideal item for an edumetric test is one that is passed with a probability of .00 on a pre-treatment administration and with a probability of 1.00 on a post-treatment administration. Edumetric tests are best suited for instructional planning and pupil evaluation. This view of test construction translates directly into the major methods of test referencing described below.

Test Referencing

Test scores must be referenced relative to some organized set of standards such as age norms, a series of ordered educational objectives, or stratified samples of broad skill domains. Donlan (1975) lists no fewer than nine types of test referencing. These include norm-referencing plus eight other types, all of which are essentially variations on criterion-referencing. As Swezey (1981) explains, norm- and criterion-referencing are methods of interpreting test scores. The major break is between the norm-referenced test (NRT) and the criterion-referenced test (CRT). The variations on the CRT are distinguishable by test content, rather than by the method of score interpretation. The major characteristics of NRTs and CRTs are outlined below.

The NRT is empirically constructed based upon the psychometric properties of a large pool of test items. Test items are selected based upon their ability to differentiate between the performance of individuals belonging to a clearly specified group. Each item is referenced, or normed, according to the relative age or grade-level of subjects who typically pass or fail the item. Since the percentage of persons who pass each item at a given age or grade-level is provided, the results provide information on the performance of an individual relative to others of the same age or grade. NRTs tend to be loaded along Carver's psychometric dimension and are generally most appropriate for screening, educational placement, and program evaluation.

Criterion-referenced instruments have proliferated in the past 20 years in response to a need for more useful information that can be translated directly into intervention strategies. In special education, the need emerges from the fact that tests normed on a nondisabled population are often inappropriate for severely impaired children. In many instances, children with severe impairments have been labelled untestable because, as noted earlier, the available NRTs could not be administered to them. Consequently, many CRTs have been developed for use with low-incidence populations with specific disabilities. Typically, these tests are not normed on large pools of subjects nor subjected to rigorous statistical analyses.

In a CRT, each item is related directly to a performance objective, generally a behavioral objective, and scores are assumed to have absolute meaning, regardless of the performance of other test-takers. Items are arranged conceptually according to some logical order--most often the developmental sequence demonstrated by nondisabled students, or the sequence of a particular curriculum to which the assessment is linked. Generally, CRT items are scored pass/fail. The inability to meet the passing criteria for a given item implies a skill deficit, and an appropriate area for training. In some cases a given item may represent a skill that is in itself a targetable objective (e.g., "scoop food from spoon with upper lip"). In other cases, items may represent specific behaviors that indirectly reflect more fundamental, generic skills (e.g., "pulls string to obtain object that is out of reach;" implying comprehension of a specific means-ends relationship). In other cases, items may be expressed entirely generically, such that any number of specific behaviors might serve to illustrate mastery (e.g., "attracts attention to self before communicating"). Criterion-referenced tests are highly related to Carver's edumetric dimension and are used most often (though not exclusively) for instructional planning and pupil evaluation.

Norm and CRTs also tend to differ in terms of measurement techniques. Whereas the typical NRT relies upon professionally administered performance items using standardized materials, (e.g., IQ tests), the CRT is more likely to involve a variety of data sources. A CRT such as the Callier-Azusa Scale (Stillman, 1978), for instance, may be completed using observational data, teacher reports, parental reports, and performance data from structured tasks. The more difficult a subject is to assess, the more critical it becomes to allow for flexible measurement techniques such as naturalistic observations and parental reports. See Hansen (1980) for a discussion of measurement techniques used in special education.

It should be noted that norm and criterion-referencing need not be mutually exclusive test properties. A few available assessments incorporate both types of referencing. For example, the Sequenced Inventory of Communication Development (Hedrick and Tobin, 1975) is a CRT that has been normed on a nondisabled population so that functional age scores may be obtained. A test designed for persons with specific disabilities may be normed on that target population instead of (or in addition to) a population of nondisabled persons. The Wisconsin Behavior Rating Scale (Song, Jones, Lippert, Metzgen, Miller, & Borreca, 1980) is an example of an assessment normed on both a population with severe impairments and a nondisabled population. The provision of norms from the target population is becoming more common in test development for populations with disabilities. Problems with using traditional NRTs and CRTs to assess children with vision and hearing impairments are discussed in the following sections.

Problems with Norm-referenced Assessments of Global Development

Difficulties in the use of norm-referenced assessments revolve around the fact that most NRTs are based upon the development of nondisabled children. The nondisabled child becomes responsive to language and social reinforcement early in life, is generally highly motivated to perform, and has a wide response repertoire. It is no wonder that measures constructed exclusively from the performance data of nondisabled children would yield little useful information on a severely disabled child. Several specific problems associated with the use of NRTs for children with multiple impairments are presented below.

Age appropriateness. Some children with deaf-blindness function developmentally on an infantile level, despite a higher level of physical maturity. The age-appropriateness of test items becomes an issue when, as with the target population, great disparity exists between a child's chronological age and his/her overall level of functioning. At least two problems arise when tests developed for infants or young children are used to assess older children and adults. First, the materials that are appropriate for infants and young children are generally inappropriate for older subjects. The lack of age-appropriate stimuli may make the testing situation unmotivating to the older subject. For example, an older child may not show the enthusiasm for a smiling face or the fascination with a mirror image that one expects from an infant; or an older child may not be motivated to manipulate the blocks, beads, and dolls that evoke curiosity in the nondisabled infant. Second, test items developed for infants assume an infantile level of motoric functioning. Many items found in cognitive or communicative subscales that are appropriate for preambulatory infants become singularly inappropriate when administered to an amubulatory child or a large, physically robust person. For instance, a person should not be expected to reach towards a desired object as a means of requesting it if s/he can stand up, walk over and obtain it independently. Thus, the items and testing materials included in a specific NRT may be inappropriate for use with subjects who differ significantly in age from the normed population.

Adaptations. Considerable disparity between competence and performance is often encountered in testing children with severe disabilities. The correct administration of items from standardized tests often fails to elicit the desired behavior, even though that behavior might be observable under slightly different circumstances. Individual children may respond to different stimuli, heavy reinforcement, social motivation, longer stimulus presentations, longer response time, etc. depending upon their motor, sensory, social or cognitive functioning. To overcome the problems of administering NRTs to children with disabilities it is tempting to rely upon "adaptations" of test items. These adaptations may involve different stimulus materials, methods of stimulus presentation, performance criteria, or response modes. Such adaptations, however, defeat the purpose of the NRT, which is to compare the performance of individuals under very carefully documented, standardized conditions. Any departure from the original testing procedure alters the results in unknown ways and renders the calculation of age or grade-equivalence scores invalid.

Lack of sensitivity. Swanson (1979) describes the difficulties in using specific subscales from NRTs, such as the Bayley Scales of Infant Development (Bayley, 1969) or the McCarthy Scales of Children's Abilities (McCarthy, 1972), with children who are severely disabled. Essentially, these types of scales are constructed to present a broad overview of development across a number of domains such as fine and gross motor skills, cognition, perception, language, etc. The number of items per subscale is likely to be relatively few, providing insufficient sensitivity to distinguish between children who develop relatively slowly. These scales are not likely to provide the in-depth information that is required by a professional interested in any one particular area of a child's development to construct specific interventions. This sensitivity problem is inherent in a psychometrically constructed test. Only items that represent rather large developmental increments are likely to distinguish reliably between age levels, since the acquisition of developmental milestones is highly variable even in nondisabled children.

Confounding of skill areas. In many NRTs certain skill areas tend to be confounded between subscales. That is items from any given subscale are likely to tap skills from other developmental areas. For instance, a cognitively-based item may involve a response requiring a certain level of motor functioning and visual acuity, or a social item may require a formal language response. In children whose development proceeds across domains at a fairly steady pace such multi-skill requirements do not present a problem. But for the child who has severe sensory or motor impairments, the assessment problem becomes severe. A child may fail most items on a subscale simply because s/he is incapable of responding in the required mode. As an example, in the first half of the motor subscale of the Bayley Scales of Infant Development, 36% of the items require intact vision. Thus, a child with a visual impairment would be expected to score poorly on this scale, regardless of actual cognitive ability. Some of this interaction between subscales is unavoidable. Cognition, cannot, in fact, be assessed without tapping motor, social, and communicative skills (Darby, 1979). However, the high degree of confounding of skill areas found in the bulk of NRTs makes them inappropriate for use with children who have severe sensory and motor impairments.

Corrections for prematurity. Another issue regarding the use of NRTs with young children relates to the question of whether to correct raw test scores for the gestational age of a prematurely born subject. Correction for gestational age implies that biological factors are the predominant influences on behavior in the early months of life. Conversely, basing scores on an infant's chronological age implies that maturational or environmental factors are the predominant influences on behavior during this time period. The choice of scoring strategy may have profound implications for an infant. Many prematurely born infants catch up with their chronological age-mates within a few months across developmental areas. Use of a corrected age may minimize discrepancies between the subject and chronological age cohorts, preventing the unnecessary labelling of the infant as developmentally disabled. On the other hand, serious developmental lags may be masked by the correction, causing a delay in the implementation of suitable intervention strategies for the needy infant. Siegel (1983) suggests that up to one year of age there is some justification for the use of corrected scores, since they do correlate well with three and five-year test scores. After a child is 12 months old, though, uncorrected scores tend to correlate better with five-year test scores.

Problems with Criterion-Referenced Global Assessments

In response to difficulties and frustrations with the use of NRTs in special education, a plethora of CRTs have appeared. These tests have the advantage of being constructed to meet the assessment needs of populations with specific disabilities. They are designed specifically to circumvent the problems of administration and lack of utility that are associated with NRTs. Unfortunately, as Rutberg (1980) notes, few such instruments are standardized, many are procedurally weak or imprecise, many do not provide clear scoring procedures, and reliability and validity data are unavailable for most of these tests. These problems are discussed below.

Procedural weaknesses. Many CRTs consist of a checklist of pertinent behaviors that are scored as present or absent. Test stimuli and the range of acceptable responses are seldom specified, and procedures may not be provided for testing those items that do not occur spontaneously. Further, criteria for mastery of individual items are often omitted. For example, the following kinds of procedural questions are encountered: Should a given behavior be observed once a year, twice a week, or five times a day before mastery is inferred? How many times should a three-item matching task be administered and what percent of correct responses is required for mastery? Without clear procedures and specific scoring criteria, the validity of the CRT is seriously impaired. Moreover, such shortcomings in a measure may result in data that is inaccurate and educationally misleading.

Lack of reliability and validity data. Validity refers to the degree to which a test measures what it claims to measure. Three types of validity are generally addressed (Mehrens & Lehmann, 1969): content validity (the adequacy with which the test samples the content area tested); construct validity (the degree to which the predictive or explanatory constructs of an underlying theory are borne out by the test results); and criterion-related validity (the relationship between the tests and other independent measures taken concurrently [concurrent validity] or at a later date [predictive validity]).

Reliability refers to the consistency of test results obtained from multiple administrations or the administration of multiple forms of the test. The three traditional types of reliability , that can be computed are (Mehrens & Lehmann, 1969): coefficients of stability (correlation of scores from successive administrations of the test); coefficients of equivalence (correlation of scores from administration of alternate test forms); and coefficients of internal consistency (correlation of items within the test to total test score). Another type of reliability that is most relevant to CRTs is inter-observer reliability. Most CRTs in special education are scored according to highly subjective judgements and observations of teachers, parents and therapists. If these tests are readministered by different personnel, discrepant scores may reflect a lack of inter-observer reliability rather than subject change.

Reliability and validity are generally considered to be the cornerstones of assessment. Thus, it is surprising that Kopp and Johnson (cited in Ruthberg, 1980) found few infant assessment measures that included reliability or validity information. Some authors (Popham & Husek; cited in Shaycoft, 1979) have suggested that the computation of reliability and validity is not only irrelevant, but detrimental to the use of CRTs. This argument is based largely on the fact that traditional reliability coefficients (i.e., stability, equivalence, internal consistency) often cannot be computed for CRTs. Shaycoft (1979), however, dispells this argument and suggests several alternative methods for computing reliability and validity coefficients for CRTs. The computation of reliability and validity measures should be an integral component of test development.

Lack of scoring standards. Some CRTs provide no method of deriving a score from test performance, while others yield only a visual profile. Obviously, such shortcomings severely limit the usefulness of the test results. It is certainly more difficult to establish a scoring system for a CRT than for a NRT. In a NRT, items can be roughly equally spaced and weighted according to their psychometric properties, thus facilitating score computation. In a CRT, however, the conceptual distance between items is somewhat arbitrary and their ordinality may not be meaningful. Still, a logical scoring system should be possible if it is based upon the theoretical perspective that guided the test's construction. Several tests based upon Piagetian theory (e.g., Dunst, 1980; Seibert, & Hogan, 1981), for instance, have scoring systems that allow the placement of a subject at a specific level of cognitive or communicative development. For a more complete discussion of guidelines for the construction and scoring of CRTs see Swezey (1981).

Ordinality and educational implications. Perhaps the most serious issue for CRTs rests in the rationale or conceptual premise underlying the sequencing of items in such measures. Some CRTs, such as the Uzgiris-Hunt Scales (1975), are based upon a clearly specified theoretical position. The ordinality of this particular scale is dictated by a clear logic that proceeds directly from Piagetian theory. Other instruments, however, lack a clearly stated conceptual approach that explains their organization. In many of the better-known CRTs, items are selected from a wide range of norm-referenced instruments and then arranged according to the sequence of acquisition observed in the development of nondisabled children. When items from different tests are combined in this manner their ordinality (even in the originally normed populations) becomes highly questionable. The use of such developmental scales in special education has been challenged by several authors (Garwood, 1982; Switzky, Rotatari, Miller, & Freagon, 1979).

Garwood (1982) discusses the fact that when items are sequenced according to psychometric norms, the conclusion is often made that the sequence is a logical, necessary and invariant one. An apparent temporal relationship between two behaviors, however, does not imply a structural relationship between them. In fact, several different developmental processes may underlie the appearance and disappearance of specific skills. The issue of ordinality becomes problematic when assessment data are tied closely to instructional consequences. If a child fails an item from a CRT, that item may be assumed to constitute an appropriate instructional objective. If the item does not represent either a functional and age-appropriate behavior in and of itself or a demonstrated prerequisite to other functional behaviors, such a conclusion is not warranted. Unfortunately, the theoretical foundation of many CRTs is too tenuous to support a 1:1 correspondence between assessment items and instructional objectives.

Assessment of Communication

Communication presents some unique assessment problems. First, communication is so intricately related to cognitive and social skills that it cannot be assessed without tapping these other developmental skill areas. In simplest terms, cognitive development dictates the content of communication. If a child can not make sense of his/her environment, then that child does not have a topic to share with another person. Social development, on the other hand, provides the motivation to communicate. If a child lacks attachment to other persons or awareness of their role as social agents in the environment, then that child has no reason to share a topic with another person. To further complicate matters, motor skills are also implicated to the extent that an expressive mode must be available for communication to occur. In the extreme case, a child may have the cognitive and social skills necessary to communicate, but may not have a motoric means of expression.

Twenty years ago, language was virtually the only recognized form of communication, and language assessments accommodated only the spoken form of language. It is only fairly recently that we have realized that communication begins before formal language appears and that language does not have to be realized through speech. Research efforts of the Center for Deaf/Blind Communication are based upon a body of literature suggesting that preverbal communicative behaviors are critical precursors of linguistic behavior (see Siegel-Causey & Guess, 1985 and Stremel-Campbell, 1985 in this document). Since most of the deaf-blind subjects in our research do not possess a formal language system, it is these preverbal communication systems that must be addressed accurately by a communication assessment.

In the past few years a number of communication assessments have appeared that incorporate this current perspective on language development and include preverbal communication items. To date, however, none includes enough items to track the communication of slowly developing children in a sensitive manner. In the deaf-blind population, intervention is so critical that it is not possible to wait for the appearance or nonappearance of the landmark milestones of preverbal communication such as pointing or waving goodbye. It is necessary to examine every possible behavior that could have communicative implications, whether conventional or nonconventional, whether intentional or preintentional. An overview of a number of the most current communication assessment instruments, categorized according to various parameters critical to their use with deaf-blind subjects is presented in Table 2. It is important to note that all of these instruments are recently developed CRTs (some are only available in experimental editions) and only one provides reliability or validity data. Unfortunately, none of the instruments listed in Table 2 are sensitive enough to track child progress at the preverbal communication level and furnish information regarding the structural relationships between items within or across the relevant skill domains. It may be advisable to develop a new communication assessment instrument specifically for the deaf-blind population. In the following paragraphs, the parameters of such an instrument are delineated.

Insert Table 2 About Here

Assessment of Relevant Domains

A thorough communication assessment should address the social and cognitive skills that are most clearly related to communication, in addition to specifically communicative and linguistic skills. Although these skills are not known precisely. a number of, authors have attempted to sort them out in an assessment format (e.g., McLean et al., 1981; Seibert, & Hogan, 1981; Stremel-Campbell, 1984). These scales are designed to track cognitive, communicative, and social skills in a parallel fashion. Stremel-Campbell (1984) tracks these areas according to developmental norms, Seibert and Hogan (1981) according to Piagetian theory, and McLean et al. (1981) according to a general theory of communicative development.

The relationship between cognitive and socio-communicative behaviors has been the subject of a great deal of recent research. Dunst (1978) has compiled a list of infant test items from eight commonly used developmental scales that tap nonverbal communicative behavior. This compilation includes many cognitive and social items and is organized according to Piagetian stages of sensorimotor development as well as the parallel communicative stages described by Bates et al. (1976). It is only by tracking these skill domains in parallel fashion that we will be able to shed light upon the nature of their interaction. For a complete discussion see Finch-Williams (1984) who summarizes the existing research on parallels between cognitive and communicative development in nondisabled children and persons with mental retardation.

Modes of Communication

A scale that is useful for young children with sensory and motor impairments must allow for nontraditional modes of comprehension and production. The scale must be flexible enough to assess very limited physical responses (e.g., eye blinks, head turns) or artificial communication systems (e.g., objects, pictures, electronic devices) as expressive and receptive language modes. In addition, the scale must also allow for multiple response modes for the subject who uses more than one mode of communication. Finally, the instrument must accommodate divergent receptive and expressive communication modes, since a child with sensory impairments may use different modes for comprehension and production.

The Use of Communication

Beyond assessing the presence or absence of specific communication behaviors, and the content (semantics) and form (syntax) of linguistic structures, a communication

Table 2. Preverbal Communication Assessment Instruments

Assessment Instrument & Subscales	Communication Aspects Specifically Assessed in Separate Strands				Target Population	Adapted for Deaf-Blind Adaptations	Scoring System
	Related Skills	Related Social Skills	Function/ Intent	Dyadic			
Communication Placement Assessment (Stremel-Campbell, 1984) (Responses to Sensory/Social Input, Interaction With Objects, Vocal Development, Receptive Communication, Expressive Communication)	X	X	X		Severely handicapped	No	Profile
Early Social-Communication Scales (Seibert, 1981) (Responding to Social Overtures, Initiating Social Interaction, Maintaining Sustained Social Interaction)	X*	X		X	Developmentally disabled	No	Score (Communication level)
Generic Skills Assessment Inventory (GSA) (McLean, et al., 1981) (Object Relationships, Representation, Dyadic Interaction, Expressive Communication, Comprehension/Imitation)	X	X	X	X	Severely handicapped	No	Profile
Gestural Approach to Thought and Language (GATE) (Langley, 1976) (No subscales)					Nondisabled	Yes**	Score
Nonverbal Prelinguistic Communication: A Guide to Communication Levels in Prelinguistic Handicapped Children. (Otos, 1983) (Tactile, Objects, Gestures & Signs) Note: This tool was not developed as an assessment instrument.					Deaf-Blind	Yes	Profile

*Cognitive skills addressed in the companion Sensorimotor Performance Profile (Siebert & Hogan, unpublished)

**Adapted version developed by: Deaf-Blind Program, University of Washington, Seattle, Washington

Table 2. Preverbal Communication Assessment Instruments, continued

Assessment Instrument & Subscales	Communication Aspects Specifically Assessed in Separate Strands: Related Skills	Related Social Skills	Function/ Intent	Dyadic	Target Population	Adapted for Deaf-Blind Adaptations	Scoring System
The Preverbal Assessment - Intervention Profile (Connard, 1984) (Visual Awareness, Auditory Awareness, Earliest Interaction, Reflex/Motor, Tactile Acceptance/Defensiveness, Visual Attending, Auditory Attending, Social Bond Attending, Orienting to Objects, Orienting to Persons)	X	X		X	Severely handicapped & multi-handicapped	Yes	Score & Profile

assessment should also address the use of communicative behaviors. To this end, a thorough assessment must track the pragmatic function, or intent, of communication. Function is the effect that communication actually has upon the social environment, while intent is the effect that the communicator intends to have upon the social environment. Needless to say, function and intent are not always congruent, especially for a person with very limited means of communication. Function is more amenable to operational definition, while intent--although it can only be inferred from the total communicative context--tells us more about the communicator. Pragmatic analyses of function and intent were originally restricted to speech acts (Dore, 1975; Halliday, 1975), but have been extended to the analysis of preverbal communication by Bates, Camaioni, and Volterra (1975) and Coggins and Carpenter (1981). Communication functions are specifically addressed in the Generic Skills Assessment Inventory (McLean et al., 1981) and the Communication Placement Assessment (Stremel-Campbell, 1984). The Communication Placement Assessment, for instance, assesses the following communication functions: protest/reject, request objects, request actions, name objects, calling, offer, repeat, request permission, ask questions, and answer questions.

Chapman (1981) points out that the effectiveness of children's communication is another important aspect of assessment. The effectiveness of communication is largely influenced by the dyadic interaction (or discourse) skills of the child--skills such as establishing, returning and maintaining eye contact with a speaker; waiting one's turn while another speaks and then filling in the silence; or attracting the listener's attention prior to speaking. Of the various aspects of communication, dyadic interaction has received the least attention in communication assessments to date. Only McLean et al. (1981) and Seibert and Hogan (1981) specifically isolate these skills in assessment format. McLean et al., for instance, assess the following dyadic interaction skills at the third level of communicative functioning: evokes attention for communication; maintains joint focus; waits turn; fills turn; establishes joint focus. Clearly both the pragmatic and dyadic aspects of communicative behavior are important components of communicative behavior use.

Sensitivity

A high degree of sensitivity is critical in a communication assessment for deaf-blind children for two reasons. First, the items must represent modest increments in skill development in order to track progress in very slowly changing subjects. Second, only a highly sensitive scale might elucidate the developmental sequences within and between social, cognitive and communicative domains. One of the opportunities provided by the assessment of a population with specific handicaps is the potential for contributing to our knowledge of developmental sequences. Longitudinal research on skill acquisition by children with specific sensory impairments aids in sorting out the relationships between specific sensory, cognitive, communicative, and social skills in the development of nondisabled children as well as disabled children. Such research may clarify the status of a specific skill--such as pointing--as a prerequsite or precursor to a later developing skill--such as verbal labelling.

Campbell and Ritchie (1983) discuss the inadequacy of empirical techniques in developmental research for determining developmental sequences of behaviors. They clearly distinquish between developmental prerequisites versus developmental precursors and discuss the importance of identifying both. Jamison and Dansky (1979) present a data-analytic procedure for identifying developmental prerequisites that depends upon a high degree of sensitivity in both item selection and item scoring. R. Fewell (personal communication, November, 1984) has developed a generic 16-point scale that might be used to score many developmental items. This system provides for scores of zero to three in four categories: frequency of response, generalization of response, initiation of behavior; and fluency of response. A sensitive scoring system, along with sensitive item selection, would increase the likelihood that a communication assessment would contribute to a theoretical rationale for communication development as well as provide sensitive tracking of student progress.

Research Basis and Theoretical Foundation

Many of the skills that are represented in communication assessments, especially the more cognitively based items, have been the topic of basic research studies within recent years. Some of this research has direct implications regarding assessment procedures or the appropriateness of specific skills as test items. For instance, Bertenthal and Fischer (1983) investigated the administration of Piagetian invisible-displacement tests of object permanence. They found that children's performance was dependent upon their understanding of the experimenter's role as agent. They suggest that the typical order in which object permanence tasks are administered may, in fact, train the appropriate response; thus, producing an illusion of systematic search for the displaced object. As another example, Bigelow (1983) examined the use of sound in the search behavior involved in object permanence tasks. Her study suggests that the role of sound in search behavior develops in the second year of life, and that "...infants do not acquire the same information about the location and/or existence of an object from hearing the object as they do from seeing the object" (p. 320). This study has important ramifications regarding the adaptation of test items for subjects with severe vision impairments. The simple substitution of objects that produce an auditory display for the traditional stimulus items in object permanence tasks may not constitute an appropriate analogue for the conventional task. Research should be reviewed for studies such as these that have potential impact upon the selection or administration of specific test items.

In a related vein, one of the most serious criticisms of CRTs is that many are not tied to a well-developed theoretical foundation. A psychometrically constructed measure need not be theory-based, but a CRT should reflect a theoretical foundation in its organization. Many assessments (e.g., Stillman, 1978; Consortium on Adaptive Performance Evaluation, 1983) are organized according to the developmental sequence of individual items from a range of norm-referenced instruments. Mere developmental ordinality, however, does not represent any specific theory of development. A number of theory-based instruments reflect the Piagetian theory of cognitive developement (e.g., Seibert, & Hogan, 1981). Other instruments reflect theories of communication development (e.g., McLean et al., 1981). Theories of social development might also form a structural basis for a communication assessment. Without a coherent theoretical foundation to guide item selection, ordinality, scoring and use, the educational implications of an assessment instrument will be severely limited.

Standardization for Subpopulations

The label "deaf-blind" covers a wide range of impairments and levels of functioning. Cognitive, motor, and sensory impairments range from minimal to severe, with all possible combinations of impairments represented. It is not reasonable to assume that one assessment will be equally applicable for all individuals in this subject population. On the other hand, the attempt to accommodate specific impairments by the mere listing of untested adaptations sabotages the validity of the test. The ideal assessment would provide different, tested versions of the instrument normed on each of the major subpopulations of children with vision and hearing impairments. These would include: a) those with severe vision impairments, b) those with severe hearing impairments, and

c) those with both severe vision and hearing impairments. In addition, all versions would also be administered to a sample of nondisabled children to standardize the forms of the measure and to provide age-norms from a nondisabled population where possible.

Generic Items

The need to accommodate different modes of stimulus input and response and the varying sensory and motor abilities of subjects has been discussed. These complications make the use of specific stimulus and response requirements problematic. A child may have mastered the underlying ability reflected in a traditional assessment item, but may be unable to perform the specific response required. To circumvent this problem, some authors (McLean, et al., 1981; Consortium on Adaptive Performance Evaluation, 1978) have used generic assessment items that describe a fundamental skill, rather than specific behaviors. For instance, rather than "Waves to another person who enters visual field and speaks to child", a generic item might read "Greets person who enters child's perceptual field". Examples of appropriate responses may accompany each generic item so that the examiner knows what specific behaviors reflect mastery of the generic item. The drawback to a generic skill inventory is that the number of test items may be fairly small. However, a sensitive scoring system (Fewell, personal communication, November, 1984) could be combined with a generic assessment to provide a wider range of potential scores and a more sensitive index of development.

Methods of Administration

The actual adminstration of an assessment may be exceedingly difficult with the target population, causing low inter-examiner reliability. Many CRTs constitute checklists of behaviors that may be scored in a flexible fashion incorporating data from several sources such as naturalistic observations, parent/teacher reports, and direct testing. While multiple data sources assure a more complete picture of the child, the psychometric properties of the test may suffer from such a flexible approach. Items that are tested directly may be scored more accurately than items that are reported from memory. Teachers or parents may not understand specific test items and may not report on the appropriate skills at all--or they may not have noticed the presence of a particular behavior in a child's repertoire. Rigorous administration guidelines and pass/fail criteria maximize the reliability and validity of an instrument.

Another problem in administration revolves around the disparity between competence and performance frequently encountered in the target population. A child with severe sensory impairments may not perform on a level commensurate with actual ability in a free-field observational setting. Chapman (1981) advocates structuring the testing situation to produce "obligatory contexts" for communication by arranging standard contexts to elicit the behaviors of interest. Cirrin and Rowland (in press) have constructed such a protocol for use with nonverbal persons with severe retardation. This protocol represents a standard set of loosely structured routines designed to elicit communicative behavior. As an example, in one routine the observer offers the subject a highly reinforcing item in a translucent container that the subject is unable to open. The subject is forced to request the observer's help in obtaining the item. A structured format also serves to standardize assessment procedures and improves the psychometric properties of the instrument.

Summary

In this paper general difficulties in the assessment of deaf-blind children have been addressed. These issues were discussed in relationship to the two major types of assessment instruments--norm-referenced and criterion-referenced tests. NRTs are likely to be inappropriate for the target population because of the extreme differences in development between the nondisabled children on whom these tests are usually normed and children with vision and hearing impairments. Difficulties with the use of NRTs include problems in their administration and the limited utility of test results. Many CRTs have been developed for populations with specific disabilities, but few have been developed for use with deaf-blind children. Many of these CRTs, however, are psychometrically and theoretically unsound. The area of communication assessment is critical to effective intervention with children who are deaf-blind. Unfortunately, a state-of-the-art communication assessment does not exist that is applicable to the target population. It is imperative that appropriate, psychometrically sound, instruments be developed to help guide training programs and to monitor the impact of such interventions. Only by developing and using such tools will children with deaf-blindness be afforded the powerful teaching techniques necessary to enhance their communication skills.

DT27

REFERENCES

Ballard, K. D. (1983). A model for the behavioral assessment of developmentally handicapped children. The Exceptional Child, 30, 175-184.

Bates, E. (1976). Language and context: The acquisition of pragmatics. New York: Academic Press.

Bates, E., Camaioni, L., & Volterra, V. (1975). The acquisition of performatives prior to speech. Merrill-Palmer Quarterly, 21, 205-226.

Bayley, N. (1969). Bayley Scales of Infant Development. New York: Psychological Corporation.

Bertenthal, B. I. (1983). The development of representation in search: a social-cognitive analysis. Child Development, 54, 846-857.

Bigelow, A. E. (1983). Development of the use of sound in the search behavior of infants. Developmental Psychology, 19, 317-321.

Bluma, S. M., Shearer, M. S., Frohman, A. H., & Hilliard, J. M. (1978). Portage Guide to Early Education. Portage, WI: Cooperative Education Service Agency #12.

Brigance, A. H. (1976). Brigance Diagnostic Inventory of Basic Skills. Woburn, MA: Curriculum Associates, Inc.

Campbell, R. L. & Richie, D. M. (1983). Problems in the theory of developmental sequences: Prerequisites and precursors. Human Development, 26, 156-172.

Carver, R. P. (1974). Two dimensions of tests. American Psychologist, 29, 518-521.

Chapman, R. S. (1981). Exploring children's communicative intents. In J. F. Miller (Ed.), Assessing Language Production in Children (pp. 111-136). Baltimore: University Park Press.

Cirrin, F. & Rowland, C. (in press). Communicative assessment of nonverbal youths with severe mental retardation. Mental Retardation.

Coggins, T. & Carpenter, R. (1981). The communicative intention inventory: A system for observing and coding children's early intentional communication. Applied Psycholinguistics, 2, 235-251.

Connard, P. (1984). The Preverbal Assessment-Intervention Profile. Portland, OR: A.S.I.E.P. Education Co.

Consortium on Adaptive Performance Evaluation. (1978). Adaptive Performance Instrument. Moscow, ID: University of Idaho, Idaho Outreach.

Darby, B. L. (1979). Infant cognition: Considerations for assessment tools. In B. L. Darby & M. J. May (Eds.) Infant Assessment: Issues and Applications (pp. 103-112). Seattle: University of Washington, Western States Technical Assistance Resource.

Donlon, T. (1975). Referencing test scores: Introductory concepts. In W. Hively & M. C. Reynolds (Eds.), Domain-Referenced Testing in Special Education (pp.29-41). Reston, VA: Council for Exceptional Children.

Dore, J. (1975). Holphrases, speech acts and language universals. *Journal of Child Language, 2*, 21-40.

Dunst, C. J. (1978). A cognitive-social approach for assessment of early nonverbal communicative behavior. *JCCD, 2*, 110-123.

Finch-Williams, A. (1984). The developmental relationship between cognition and communication: Implications for assessment. *Topics in Language Disorders, 5*, 1-13.

Garwood, S. G. (1982). (Mis)use of developmental scales in program evaluation. *Topics in early childhood special education, 1*(4), 61-69.

Halliday, M. (1975). Learning how to mean. In E. Lenneberg & E. Lenneberg (Eds.), *Foundations of Language Development: A Multidisciplinary Approach, Vol. 1*, (pp. 239-265). New York: Academic Press.

Hansen, C. L. (1980). Developing and validating assessment instruments. In C. L. Hansen & N. G. Haring (Eds.), *Child assessment: The Process and Product* (pp. 131-148). Seattle: University of Washington, Program Development Assistance System.

Hedrick, E. P. & Tobin, A. (1975). *Sequenced Inventory of Communication Development* (SICD). Seattle: University of Washington Press.

Jamison, W. & Dansky, J. L. (1979). Identifying developmental prerequisites of cognitive acquisition. *Child Development, 50*, 449-454.

Langley, B. (1976). *Gestural Approach to Thought and Expression*. Nashville: Peabody College.

McCarthy, D. (1972). *McCarthy Scales of Children's Abilities*. New York: Psychological Corporation.

McLean, J. E., Snyder-McLean, L., Rowland, C., Jacobs, P., & Sack, S. (1981). *Generic Skills Assessment Inventory*. Lawrence, KS: University of Kansas, Bureau of Child Research.

Mehrens, W. A. & Lehmann, J. J. (1969). *Standardized tests in education*. New York: Holt, Rinehart & Winston.

Otos, M. (1983). *Nonverbal Prelinquistic Communication: A guide to communication levels in prelinguistic handicapped children*. Salem, OR: Oregon Department of Education.

Rudolph, J., & Collings, M. (Eds.). (1978). *A Manual for the Assessment of a "Deaf-Blind" Multiply Handicapped Child* (3rd ed.). Lansing, MI: Midwest Regional Center for Services to Deaf-Blind Children.

Rutberg, J. (1980). New infant assessments need standards, quality assurances. *Emphasis, 4*(2), 6.

Ruttenberg, B. A., Kalish, B. I., Wevar, C., & Wolf, E. G. (1977). *Behavior Rating Instrument for Autistic and Other Atypical Children*. Chicago: Stoelting.

Seibert, J. M., & Hogan, A. E. (1981). Extended Profile for the Early Social Communication Scales. Miami: University of Miami, Mailman Center.

Shaycoft, M. F. (1979). Handbook of criterion-referenced testing. New York: Garland STPM Press.

Siegel, L. S. (1983). Correction for prematurity and its consequences for the assessment of the very low birth-weight infant. Child Development, 54, 1176-1188.

Song, A., Jones, S., Lippert, J., Metzgen, K., Miller, J., & Borreca, C. (1980). Wisconsin Behavior Rating Scale. Madison, WI: Central Wisconsin Center for the Developmentally Disabled.

Stillman, R. (Ed.) (1978). The Callier-Azusa Scale. Dallas: Callier Center, University of Texas, Callier Center for Communication Disorders.

Stremel-Campbell, K. (1984). Communication Placement Assessment Inventory. Monmouth, OR: Teaching Research Division Oregon State System of Higher Education.

Swanson, J. E. (1979). Principles of infant assessment. In B. L. Darby & M. J. May (Eds.), Infant Assessment: Issues and Applications (pp. 19-26). Seattle: University of Washington, Western States Technical Assistance Resource.

Swezey, R. W. (1981). Individual performance assessment: An approach to criterion-referenced test development. Reston, VA: Reston Publishing.

Switzky, H., Rotatari, A. F., Miller, T., & Freagon, S. (1979). The developmental model and its implications for assessment and instruction for severely/profoundly handicapped. Mental Retardation, 176, 167-170.

Uzgiris, I. & Hunt, J. McV. (1975). Assessment in infancy: Ordinal Scales of Psychological Development. Chicago: University of Illinois Press.

DT27

II. *Tactual/Tactile Assessment

Patty A. Hart and Charles R. Spellman

The assessment of the tactual/tactile input mode is of critical importance in developing communication training programs for children with deaf-blindness. For many of these individuals this sensory mode may be the most efficient and effective conduit for receiving communication (eg., devices are now being tested that transmit sound through tactile patterns on the arm or leg). Unfortunately, systematic procedures for assessing, stimulating, or even documenting change in this receptive langauge channel are noticeably lacking. For instance, only one assessment instrument has been designed specifically for use with young children in the target group (Schery & Glover, 1977/78).

It is apparent, then, that more attention needs to be directed to this type of evaluation approach. Thus, the purpose of this manuscript is to identify and describe existing assessment procedures that may have implications for use with pre-school children with deaf-blindness. The review is divided into three sections: product assessment, functional assessment, and experimental procedures. Included within each section are suggestions for adapting the various procedures for use with children in this disability group.

Prior to proceeding, it should be noted that this review does not include literature on investigations of oral/tactile sensation. Those interested in this specific area of tactual/tactile research should review: Bosma, J. F. (Ed.). (1967). Symposium on oral sensation and perception. Springfield, IL: Charles C. Thomas; or Bosma, J. F. (Ed.). (1970). Second symposium on oral sensation and perception. Springfield, IL: Charles C. Thomas.

Product Assessment

Product assessment refers to tests that measure a subject's skills and abilities. This type of assessment approach provides an outcome describing the individual's level of proficiency or achievement in a particular domain. Common examples of such measures include achievement and intelligence tests. Product approaches that may be employed with children who are deaf-blind include measures of tactual/tactile acuity, habitation/novel matching, and cross-model transfer.

Acuity

Acuity refers to an individual's threshold for detecting a tactual/tactile stimulus on the basis of one or more characterisitics (e.g., temperature, pressure, location). Stated otherwise, it is the capability to discriminate between stimuli. Rutherford and McCall (1967) devised a test requiring subjects to detect with their tongue grooves that were engraved in a smooth piece of plastic. The depth of the grooves graduated

---

*For the purpose of this paper, tactile shall be used to describe the stimulation of passive skin receptors. Tactual refers to active touch that involves the kinesthetic system and is characterized by manipulation and exploration.

from .5 millimeters to five millimeters in 10 steps. A total of 11 plates, 10 with different sized grooves and one that was smooth, were used in the study. Each plate, in random order, was passed over the subjects' tongues. After each pass, the subject indicated in some manner whether or not a groove was felt. Thresholds of tactile acuity were obtained for each subject by determining the groove depth that could be detected on 50% of the trials. In comparing a group of teenagers with cerebral palsy to a group of teenagers with no apparent handicaps, it was found that the former group had poorer acuity on tongue tips than the latter group. The group of students without handicaps had a median threshold of .25 millimeters. Conversely, within the group of students with cerebral palsy two subgroups of subjects (persons with either spastic or athetoid cerebral palsy) obtained median thresholds of .45 millimeters and .54 millimeters, respectively.

Another measure of tactile acuity is a two-point discrimination, which measures the distance at which an individual can judge if s/he has been touched by two points or one. In a study conducted by Guyot, Johnson, and Weaver (1981) subjects were touched on the forearms, at either one point or two simultaneous points, by stimuli various distances apart during distinct blocks of trials. The first trial was followed immediately by a trial that was either the same as the first trial or varied in some way (e.g., change from a one to two point discrimination). It should be noted that the distance of the two-point separation remained the same for each block of 20 trials. The subjects were asked to report whether the second trial was the same or different from the first, and correct and incorrect responses were recorded. The procedure continued in blocks of 20 trials. It was found that the college students used as subjects in this study were able to discriminate reliably between two-point separations as small as two millimeters.

The two-point discrimination was also used by Rutherford and McCall (1967) in comparing the acuity of teenagers with cerebral palsy and teenagers with no apparent handicaps. Using a modified caliper discriminations were measured on the tongue tip, both sides of the upper lip, and both sides of the tongue. The only significant difference between the groups was on the nondominant side of the tongue. The students with cerebral palsy had a median threshold at this site .025 inches poorer than the group of students with no handicaps. A variation of the two-point discrimination was also employed in a second part of this study. Individuals were touched twice, in rapid succession, on the tongue and then asked if they were touched in the same or different points. Surfaces tested were the same as in the two-point discrimination. For this approach no significant differences were found between the two groups. This finding might indicate that the information yielded from the first and simpler format is not as precise as in the latter two-point discrimination test.

A number of variations of the two-point discrimination could be employed for assessing children who are deaf-blind to verify sensations, yes-no responses, or other operant responses that are available to the child. Such results could be utilized to determine the appropriateness of various communication modes that involve tactual/tactile stimuli (e.g., braille or other raised symbols, finger spelling, tactile/vibration devices) and to define the stimulus characteristics of a communication mode required for the child's detection or discrimination. Another application of acuity tests would be to locate the area of the child's body surface that is most sensitive to tactual/tactile stimulation so that efforts to use tactual/tactile cues in communication and instruction would be maximally effective.

Habituation/Novel Stimulus

Habituation has been used as a method of assessing the discrimination abilities of very young children. Gibson (1969, p. 327) states, "If continued exposure to a given stimulus source is accompanied by a decreased response in the infant and followed, in contrast, by an increased response when a new stimulus source is presented, we have evidence that some property of the two sources is differentiated, even though the attentive response is not specific to the stimulus." Numerous studies (Fagan & Singer, 1983) have been reported in which the habituation method has been used with very young children.

A procedure employing the preference for novel over familiar stimuli was used by Gottfried and Rose (1980) in assessing tactual recognition memory in infants. Infants who were one year old, with no apparent handicaps, served as subjects in this study. Initially, each child was given 10 to 15 minutes to become familiar with the experimental setting. After this time, a tray containing five identical objects was presented for the infant to explore and examine. After one minute, the tray was withdrawn and a two-phase recognition process began. In the first task the tray was presented to the subjects that contained the five identical objects that were introduced initially, plus five new identical objects. All objects were placed randomly on the surface of the plates. The infant was then allowed to play with and examine the objects. In the second task, the recognition was conducted with the lights off, so that the infant couldn't see the objects that were being handled. In both phases the infant's behavior was videotaped (in darkness this was done with an infrared light). The amounts of time the infant spent manipulating novel and familiar items both in light and darkness was recorded, and the percentage of time each infant spent manipulating the novel stimuli was calculated. It was found that the infants in the study spent an average of 60% to 70% of the second recognition phase mouthing or manipulating the novel objects, a result that is above chance responding (i.e., 50%). Thus, it appears that most of the one year olds in the study were able to discriminate tactually between novel and familiar shapes.

Although fairly sophisticated equipment was used in this study, the approach could be modified for other settings. For instance, blindfolding the child would eliminate the need for darkness and infrared light, or the test items could be presented in a covered box (see the next section for a discussion of the "lookie-feelie" box); the videotape equipment could be eliminated by having one or more observers record the subject's actions; and, when used as a tactile assessment procedure, only the second task (lights off condition) would be needed. However, by comparing the results of both tasks (i.e., manipulation in the light and the dark) it should be possible to get an indication of the power of the child's visual system. Vision, no matter how limited, should help the child in making observations about the stimulus objects in the familiarization stage of the first task (lights on). Therefore, conducting the procedures with and without visual input could yield different results with a population of children with deaf-blindness, and lead to important conclusions about the extent of the child's residual vision and the child's integration of visual and tactual information.

Matching

Davidson, Pine, and Wiles-Ketterman (1980) used a matching approach to assess the tactile/tactual abilities of retarded and nonretarded school-age children. The test stimuli were presented in a "lookie-feelie" box (A box with a lid and that is at least the size of a shoe box is used to make a "lookie-feelie" box. Two holes for inserting the hands are cut in one side of the box) (Davidson, Cambardella, Stenerson, & Carney, 1974). In the study three sets of stimulus objects, with 10 items in each set, were used: Set 1 was composed of objects that were familiar to the subjects (e.g., comb, orange, pencil, coffee cup, small book, hair brush, child's shoe, fork, spoon, and key); Set 2 consisted of unfamiliar two-dimensional shapes of black lucite from the Gibson letter-like form set (Gibson, Gibson, Pick, & Osser, 1962); and Set 3 contained items from the Gibson free-form solids set (Gibson, 1966) that have a smooth bottom and a humped top that is surrounded by five protuberances.

The test used a delayed match-to-sample paradigm. Prior to testing each subject was given a warm-up session with nontest items to make sure that the test was understood. Each trial began with the exploration of one sample, i.e., one standard item from Set 1 was presented in the "lookie-feelie" box. Next, two items -- one a standard item (from Set 1) and one an item that was randomly selected from either Set 2 or 3 -- were presented simultaneously in the box for inspection. The subject then indicated which of the two items belonged to the same set as the original sample item by removing the chosen item from the box.

Because the Davidson et al. (1980) procedure used a delayed match-to-sample task the sample was not present at the time the match was made. In effect, the subject was called upon to "remember" the sample. Pick (1965), in a similar study, found that performance on a tactual matching task improved when the sample was continually available for comparison. It would be possible to alter the previously described procedure to embody this simple change. In this fashion memory could be minimized as a factor in test performance.

The match-to-sample task could also be altered to assess a child's tactual sensations across a wide range of stimulus characteristics. For instance, the subject could be required to match textures (e.g., smooth silk or rough sandpaper), two cold items (e.g., ice cubes), or warm items (e.g., warm water or a heating pad). Since the match-to-sample procedure is a common instructional technique, this form of assessment would have the advantage of serving as both an evaluative and a teaching procedure.

Cross Modal Transfer

A number of tests of tactile perception and memory require that the subject obtain information about the stimuli through both the tactile and visual modes. In one study (Meltzoff & Borton, 1979) it was shown that newborn infants are capable of visually recognizing shapes that have been put into their mouths. Infants who were 26 to 33 days old with no apparent handicaps were used as subjects. Stimulus objects were two pacifiers, one having a smooth nipple and the other having a nipple with eight protrusions or nubs. A large picture of each pacifier (diameter of 6.4 centimeters) was constructed from styrofoam for the visual part of the test and painted orange.

The first phase of the experiment consisted of a 90 second tactile familiarization stage in which the infant was allowed to suck on one of the two pacifiers that was randomly selected by the experimenter. The infants were prevented from seeing the pacifier as it was inserted or removed from their mouths by a research aide. At the end of the familiarization stage the lights in the room were turned off and the infant turned to face the pictures of the two pacifiers. The second stage began when the lights were turned on. It consisted of a 20 second simultaneous presentation of the pictures of the two pacifiers, with the right and left positions being alternated randomly. Timing began as soon as the infant fixated on one of the shapes and the time spent fixating on each object during the twenty-second period was recorded. Fixation was considered to have occurred when an observer directly in front of the infant saw one of the objects reflected in either of the infant's pupils. The results of this study indicated that infants fixated 71.8% of the time on the shape that had been in their mouth. A replication with another group of newborns resulted in 67.1% fixation to the mouthed stimulus. Thus, it was concluded that the infants could visually recognize a familiar stimulus even though only the tactile characteristics of the object were known.

Since this testing approach has been employed successfully with newborns, it may be appropriate for use with the target population. The original procedure could be used with children with limited vision if the visual stimuli are made large and bright enough for the child to distinguish between them. Results from this type of assessment could suggest the extent of a child's integration of visual and tactile sensation, and whether the concept of stimulus equivalence was established. It should be noted, however, that children with little or no vision would not be expected to perform in a valid fashion on this assessment.

Functional Assessment

The California Initial Communication Processes (Schery & Glover, 1977/78) is a measure that purports to measure skill areas that precede repetitive and expressive language. One of the scales in the test is dedicated to the assessment of tactile abilities and consists of 12 items: a) demonstrates total body response to tactual stimulating; b) tolerates touch; c) tolerates handling; d) tolerates tactual environmental stimuli; e) demonstrates discrete body responses to tactual stimulating; f) explores objects tactually; g) demonstrates differentiated response to temperatures; h) demonstrates differentiated response to texture; i) demonstrates differentiated response to object--tactual only; j) locates body part tactually stimulated; k) searches for object tactually; and l) locates object tactually. In order to "pass" each item, the student must have performed the behavior on approximately 80% of appropriate occasions in the past, or in two out of three separate observations. Instructional objectives that are available with the instument can be used to tailor an intervention to meet the individual's measured skills and limitations. A field test of the original scales was conducted with 360 special education students at developmental levels below three years. Of these subjects, 76 students were classified as being multiply handicapped, including deaf-blind. Unfortunately, during pilot testing the authors were unable to obtain reliable data on the tactile scale. Thus, the scale was deleted from the final instrument.

Despite this problem the approach offers a reasonable starting point for those wishing to develop a functional tactual/tactile assessment model. The scale does represent an initial attempt to quantify observable reactions to tactual/tactile stimuli and contains a number of behaviors that, when present, allow for some conclusions to be made about a child's tactile abilities. Further, it should be noted that the problems of reliably measuring subtle and/or inconsistent responses within the target group are not limited to this assessment. As with other measures of sensory capabilities, the absence of a reliable response is an ambiguous finding and may not reflect an absence of sensation. A major challenge to those who serve young children who are deaf-blind is to gain control over an operant response that can serve as a means of communication. This type of response is equally necessary for the reliable assessment of sensory systems; thus it is possible that advances in training technologies will benefit the practice of assessment with this population.

Experimental Procedures

Contingency intervention, a teaching method developed by Brinker and Lewis (1982), has been used successfully with retarded and multiply handicapped children in demonstrating behavior change. In this seminal investigation the skills that were taught to each subject were not predetermined. Rather, each infant was observed and existing movements were identified (eg., foot kick, arm lift). Using a multiple baseline design across two behaviors, a presumably positive consequence was provided for one movement but not for the second one. The consequence was applied to the second behavior only after the first behavior had increased to at least 25% over the baseline rate. If the consequence began to lose its effectiveness the contingency was changed. It should be noted that neither the procedures nor the results are presented in detail in the narrative. Thus, it is difficult to replicate and/or fully critique the study. Assuming that the description that is provided adequately reflects the results, this procedure may provide a model for sensory assessment that holds promise for the target population.

The assessment procedures could be administered without elaborate equipment. For example, actometers, similar to wrist watches, could be useful in measuring the movement responses of the subjects. Commercially available actometers have been proven to be reliable measures of activity level (Eaton, 1983). These instruments may be practical when using this method in a classroom setting, if the target behavior is a gross motor activity.

An added benefit of Brinker and Lewis' (1982) procedure is that it gives the participating child valuable opportunities to learn. Handicapped infants, particularly those who are deaf and blind, often need to discover that their actions have consequences. Thus, the contingency intervention model may represent both a means of assessment and a method of teching. Further, the procedure could be modified to allow for tactile assessment, using consequences such as stroking or vibration. If there is an increase in the target behavior, it can be assumed that the child "experiences" the consequences, or that s/he receives information from the tactile modality. Obviously, one cannot assume that the child has a sensory dysfunction if the target behavior does not increase. A number of other factors could be responsible for this. For those who do demonstrate a change in behavior, the procedure could be applied further to assess thresholds of perception by determining the weakest stimulus which elicits the target behavior.

In one study (Utley, Duncan, Strain, & Scanlon, 1983) the success of the contingency intervention model was demonstrated with four multihandicapped children from 1½ to 2½ years old. All four children were described as profoundly retarded, and one was labeled as being cortically blind. For this research, the children were positioned in their cribs lying down or in a restrained sitting pose. A visual display mounted on cardboard was placed 35 centimeters in front of each child's face. The visual display consisted of a shielded night light in the center of the cardboard surrounded by a string of 60 Christmas lights. Oblong openings were cut into the sides of the display for observers to look through. The target behavior was visual fixation by the subject. The child was judged to be fixating on the display if the observer could see the light reflected in the cornea. The consequence of fixation was the onset of the entire light display. Two five-minute sessions per day were conducted. During one session, the entire display was lighted for the full five minutes (noncontingent condition). During the other session, the night light was on constantly, and the Christmas lights were turned on and off as the child fixated on the night light (contingent condition). All four children showed increased fixation during the contingent sessions within a few days, a finding significant for two reasons. First, all the children --- including the subject with blindness --- demonstrated visual awareness. Second, the children showed the ability to respond to visual displays contingently, an important factor for future learning.

By modifying these procedures (e.g., substituting vibrations for Christmas lights), this procedure could be used in assessing a variety of tactile variables for subjects with limited response repertoires. Examples of a classroom applications of this approach would be to stroke the child's face or back every time he/she kicks a leg, or the child might be placed on a vibrating surface with the switch activated by vocalizations from the child. An additional application of this procedure would be to identify consequences that are reinforcing to an individual.

Summary

Almost all of the procedures described in this review need to be modified or combined with other measurement procedures before being appropriate for the target population. Moreover, some of the procedures are not designed solely to assess tactual/tactile capabilities, but do provide a reasonable starting point in conceptualizaing an assessment paradigm for students with sensory impairments. Clearly, research should be conducted to develop suitable measurement tools and procedures in this area.

In conclusion, this is an initial review and it is not intended to be a comprehensive synthesis of all the available tactual research literature. For those who wish a more indepth discussion of portions of this applied and theoretical literature, the following primary sources are recommended:

Gibson, E. J. (1969). *Principles of perceptual learning and development.* Englewood Cliffs: Prentice-Hall.

Schiff, W., & Foulke, E. (Eds.). (1982). *Tactual perception: A source book.* New York: Cambridge University Press.

Walk, R. D., & Pick, H. L., Jr., (Eds.). (1981). *Intersensory perception and sensory integration.* New York: Plenum Press.

SFF85

References

Bosma, J. F. (Ed.). (1970). Second symposium on oral sensation and perception. Springfield, IL: Charles C. Thomas.

Brinker, R. P., & Lewis, M. (1982). Contingency intervention. In J. D. Anerson (Ed.)., Curricula for high-risk and handicapped infants. Chapel Hill, NC: TADS.

Davidson, P., Cambardella, P., Stenerson, S., & Carney, G. (1974). Influences of age and and task's memory demand on matching shapes within and across vision and touch. Perceptual and Motor Skills, 39, 187-192.

Davidson, P. W., Pine R., & Wiles-Kettenmann, M. (1980). Haptic-visual shape matching by mentally retarded children: Exploratory activity and complexity effects. American Journal of Mental Deficiency, 84(5), 526-533.

Eaton, W. O. (1983). Measuring activity level with actometers: Reliability, validity, and arm length. Child Development, 54, 720-726.

Fagan, J. F., III, & Singer L. T. (1983). Infant recognition memory as a measure of intelligence. Advances in Infancy Research, II, 31-78.

Gibson, E. J. (1969). Principles of perceptual learning and development. Englewood Cliffs: Prentice-Hall.

Gibson, E., Gibson, J., Pick, A., & Osser, H. (1962). A developmental study of letter-like forms. Journal of Comparative and Physiological Psychology, 55, 897-906.

Gibson, J. (1966). The senses considered as perceptual systems. Boston: Houghton-Mifflen.

Gottfried, A. W, & Rose, S. A. (1980). Tactile recognition memory in infants. Child Development, 51, 69-74.

Guyot, G. W., Johnson, F. D., & Weaver, C. (1981). Two-point tactual discrimination: A signal detection approach. Perceptual and Motor Skills, 52, 433-434.

Meltzoff, A. N., & Borton, R. W. (1979). Intermodal matching by human neonates. Macmillan Journals, Ltd., 282, 403-404.

Osofsky, J. D. (Ed.). (1979). Handbook of infant development. New York: John Wiley & Sons.

Pick, A. (1965). Improvement and tactual form discrimination. Journal of Experimental Psychology, 69(4), 331-339.

Rutherford, D., & McCall, G. (1967). Testing oral sensation and perception in persons with dysarthria. In J. Bosma, (Ed.), Symposium on oral sensation and perception. (pp. 188-200) Springfield, IL: Charles C. Thomas.

Schiff, W., & Foulke, E. (Eds.). (1982). Tactual perception: A source book. New York: Cambridge University Press.

Schery, T. K., & Glover, A. (1977/78 edition). California initial communication processes. Unpublished manuscript. C.A.R.E. Project, Grant #G00-76-05898, United States Office of Education, Bureau of Education for the Handicapped.

Utley, B., Duncan, D., Strain, P., & Scanlon, K. (1983). Effects of contingent and noncontingent vision stimulation on visual fixation in multiply handicapped children. The Journal of The Association for Persons with Severe Handicaps, 8, 29-42.

Walk, R. D., & Pick, H. L., Jr. (Eds.). (1981). Intersensory perception and sensory integration. New York: Plenum Press.

SFF85

III. Visual Assessment

Pamela J. Cress

The complexity of the human visual system has been a source of curiosity for many researchers. The bulk of recent investigations have focused on the measurement of those aspects of vision that may be indicative of visual impairment including: eye anomalies and pathologies, reduced levels of visual acuity, contrast sensitivity, stereopsis, visual fields, and eye motility. Both physiological and behavioral measures have been used in these types of assessments. Physiological measures are employed predominantly by the medical community. Educationally-oriented visual assessment, on the other hand, has generally utilized behavioral measures. A truly comprehensive assessment of an impaired visual system for medical and educational purposes would involve the use of both types of measurement approaches to gain an accurate profile of a subject's visual capabilities.

The primary goal of this literature review is to identify visual assessment procedures that have been used with infants and older subject populations, with limited response repertoires, that have potential application for children ages 0 to 5 years, who are suspected of being deaf-blind. The specific testing approaches reviewed include: physiological measures, functional assessment, and behavioral measures. Several of the techniques that are discussed were developed, and are currently used by, the medical community in the detection, diagnosis, and treatment of visual impairment with pediatric patients. Other approaches that are reviewed come from the fields of developmental psychology, physiology, and other disciplines that share an interest in vision research. Where possible, an attempt has been made to suggest the extent to which the results of the various procedures might prove useful in planning educational or therapeutic interventions for the target population.

It should be noted that the measurement techniques described herein have rarely been used in planning interventions for children with deaf-blindness. This population has historically been hard to assess with most standard visual assessment procedures; however, many of the newer procedures reported in this manuscript hold promise for obtaining information about a these children's visual capacities. It is hoped that this review will aid in the further conceptualization and development of such visual assessment methods.

Physiological Measures

Much can be learned about a person's visual system without requiring a subjective or behavioral response from that individual. Some widely used techniques for evaluating the subject's visual status involve the direct inspection of the physical characteristics of the eye. These techniques include ophthalmoscopy (inspection of the anterior portions of the eye such as the retina, macula and agueous humor), retinoscopy (determination of the refractive status of the eye), and the evaluation of Hirshberg reflex and various fixation tests (measures of eye alignment, dominance, and motility). These procedures are used routinely by ophthalmologists and optometrists and are not reviewed in this paper. Recent reports of the experimental use of photography and computers to measure refractive status and eye alignment (Howland & Sayles, 1983; Atkinson & Braddick, 1982; Kaakinen, 1979) may have implications for screening large numbers of children and could facilitate earlier detection of visual problems. But, since these techniques provide information already obtainable through existing routine procedures it seems that they have little relevance for assessing the target group. Two broad methods of physiological assessment that do appear to be appropriate for use with the target population are discussed in the rest of this section.

Electrophysiological Techniques

Electrophysiological techniques for measuring visual functions constitute a major area of current vision research. Two such procedures are the visually evoked response (VER), also referred to as visually evolved potential (VEP), and the electroretinogram (ERG). Both of these approaches are used widely in the diagnosis and evaluation of eye disease, particularly with the unresponsive patient who has suspected visual pathology. Further, both the VER and the ERG utilize electrodes attached at specific locations in the head region to measure electrical responses along the neural paths of the visual system in the presence of controlled visual stimuli. More specific descriptions of these techniques follow.

The VER measures cortical stimulation in the subject's brain that results from the presentation of controlled visual stimuli. (Sokol, 1976, 1980, has reviewed VER research with infants and provides a good introduction to the topic.) The simplest version of this procedure involves the use of a circular flourescent light, often called a "flash-ring," while electrodes attached to the head transmit data on the neural response to this stimulus to a computer for summation and graphing. The flash-ring is sufficiently intense that the person being evaluated need not be conscious and the results can prove useful in locating optic lesions, tumors, and other serious pathology or anomaly. The flash-ring VER has limited usefulness, however,when questions of specific visual functions arise. For such issues a elaborate VER procedure, referred to as pattern VER, is more appropriate. It employs a computerized graphics display as a stimulus variable to assess visual functions such as acuity (Dobson & Teller, 1978) or use of visual fields (Wolfe, 1979). As with the simpler technique, limited cooperation from the person being assessed is required.

Numerous reports can be found documenting the use of the pattern VER approach to test the visual acuity of infants (Baraldi, Ferrari, Fonda, & Penne, 1981; Braddick & Atkinson, 1982) and young children with neurological handicaps (Dubowitz, Mushin, Morante, & Placzek, 1983; Mohn & Van Hof-Van Duin, 1983). Unfortunately, most researchers have found a tendency for the VER approach to overestimate acuity in young children when compared to behavioral measures (Dobson & Teller, 1978), and some children show wide differences between VER and behavioral acuities (Baraldi, et al., 1981). In addition, some individuals may be difficult to test with VER procedures. Persons who withdraw from tactile stimulation, have poor neck and head control, frequent seizure activity, and those who tantrum often or have high frequency stereotypic behaviors (e.g., head shaking or rocking) may not tolerate the placement of electrodes to the head for the duration of testing. An additional requirement in pattern VER testing is the maintenance of visual orientation to the graphic display. This behavior may be difficult to elicit from some individuals, especially those persons with little interest in the visual stimuli or who are otherwise noncompliant. Despite these limitations, VER procedures are seen as a significant advance within the medical community and the implications of their findings for educators should be fully explored.

The ERG is another electrophysiologic measure used by the medical community that yields information about retinal function. (Carr & Siegal, 1982, and Lawwill, 1971, provide descriptions of current ERG uses.) Procedurally the ERG is quite similar to the pattern VER, with the major difference being the location of the electrodes on the head. Much of the discussion regarding the problems of electrode placement and maintenance of visual orientation in VER testing apply equally to the ERG. Nevertheless, the ERG appears to be a useful tool in the medical diagnosis and evaluation of certain visual impairments. One of the potential uses of ERG results would be to predict the degree of useful vision in persons with eye disease involving the retina (e.g., retinitis pigmentosa, retrolental fibroplasia, and diabetic retinopathy.) Implications of this procedure for answering program design questions for the target group need to be investigated.

Optokinetic Nystagmus

Another procedure for measuring visual acuity through physiologic means is optokinetic nystagmus (OKN) (Gorman, Cogan & Gellis, 1957). Variations of this procedure have been reported, all of which involve the presentation of a moving visual target (usually a vertical stripe) to the subject with the intention of inducing a reflexive nystagmic eye movement. If the target is varied across one of several dimensions (e.g., size, distance, speed) until the OKN response is no longer present, a measure can be obtained of the smallest (or farthest) target that can be resolved into stripes by the subject's visual system. This finding is considered to be the acuity threshold of the subject.

Acuities obtained by OKN compare well with those obtained by behavioral methods (Dobson & Teller, 1978). Observers report that the response, when present, is robust and easy to measure. The absence of the OKN reflex in some persons, though, does not reliably predict severe visual impairment. Other factors may account for failure to elicit OKN, such as lack of attentiveness (Dayton, Jones, Aiu, Rawson, Steele, & Rose, 1964). One apparent limitation of the use of OKN testing for assessing visual acuity is a shortage of trained personnel and equipment necessary to the procedure. But, where available, the procedure could prove useful in evaluating the vision of young children in the target population.

Functional Assessment

Functional vision is a generic term that refers to those visual skills that are considered to be critical to everyday living. Various assessments have been developed to measure functional vision. These measures include items to assess the tracking of objects, use of visual fields, eye-hand coordination, and other functions that reflect visual development. Several commercially available tools for assessing functional vision have been developed for use with special populations. The Visual Efficiency Scale (Barraga, 1970) was developed for children whose visual impairment is their only disability; as was the Visual Functioning Assessment Kit (Costello, Pinkney and Scheffers, 1982). Langley's Functional Vision Inventory for Severe and Multiply Handicapped (1980) is intended, obviously, for a different target group. Rock, Litchfield, Jans, Schulz, Ulrich, Pray, and Vedovatti (1983) described a procedure they call the Low-Functioning Assessment Kit and Gates, Berry, and Reid (1979) developed the Revised Manual for Visual Assessment Kit. Finally, Sailor, Utley, Goetz, Gee, and Baldwin, (1982) developed a visual assessment manual which was intended for use with school-aged students who are deaf-blind. Numerous versions of this type of assessment approach have been developed and used locally by school districts, state departments of education, preschool programs, and other programs.

With the exception of the Barraga and Costello et al. procedures (which require complex communication and motor skills), each of these procedures contain essentially the same test items. Since none of the authors report reliability or validity idices for the assessments, no comparisons can be made as to their relative merits. Clearly, a psychometrically sound tool is needed to detect abnormal visual development and to measure the extent of useful vision available to the individual with a visual impairment. Ideally, such an assessment would allow for screening and evaluation of children of various ages and handicapping condition, and would provide prescriptive information for educational programming, and environmental modifications.

Behavioral Measures

Many of the techniques employed in the diagnosis and evaluation of visual impairment involve a subjective, or behavioral, response from the subject whose vision is being assessed. Routine tests for visual acuity, contrast sensitivity, stereopsis, and visual fields depend upon responses that require fairly sophisticated communication skills and high levels of stimulus control. Consequently, young children with deaf-blindness, who typically show delays in these two areas, rarely provide meaningful data on standard behavioral visual assessment procedures. Several methods, however, appear to hold potential for the target population. In the following sections measures of visual acuity, contrast sensitivity, visual fields, and stereopsis will be described.

Visual Acuity

Traditional acuity tests measure the individual's ability to "recognize" or identify a letter or other figure. More specifically, such tests assess the clarity of vision in the foveal (central) portion of the retina. Due to the usefulness of acuity scores in the medical diagnosis and treatment of visual impairment, and because of the value of such scores in vision screening programs for preschool and school-aged children, a great deal of effort has been spent in adapting and modifying tests of visual acuity for use with younger populations (Fulton, Hansen, & Manning, 1981). As a consequence of this emphasis several versions of simplified recognition acuity tests have been developed. Excellent reviews of many of these tests can be found in Stangler, Huber, and Roth (1980), Barker and Barmatz (1975), Taubenhaus and Jackson (1967), and Wolf and Harvey (1959).Typically, visual acuity is measured at a distance of 10 to 20 feet (far-point testing) and at a distance of several inches (near-point testing). Controversy exists regarding the validity of near-point acuity tests for screening preschool children, since these children can theoretically suppress hyperopia for short periods of time, such as the duration of testing. Near-point tests are often included in vision screening programs for older children and adults, since the measures may detect hyperopia or amblyopia and because the tests approximate viewing conditions found in most educational tasks. Near-point tests also provide a means of assessing persons with low vision who can't see the targets used in far-point testing.

A drawback to any standardized acuity test when used with persons who are severely visually impaired, is that the measures utilize as the largest target a figure equivalent to 20/200 acuity. This index may represent the best possible performance within the target group. Thus, modifications of test distances and procedures may be required with many of the existing assessments to extend their use to the target population. Commonly used visual acuity measures and their applicability for children with deaf-blindness, are discussed below.

Snellen E. Developed in the late 1800's for use with "illiterates" of all ages, the linear Snellen E is the far-point acuity test against which other such tests are compared.

The standard procedure for this test involves discriminating the directional orientation of identical targets (E's), a skill that may not be mastered by normally developing children until five or six years of age. Another limitation to the use of this test with young deaf-blind children is the necessity of communicating one's response using words or gestures.Nonetheless, efforts have been made by several investigators (e.g., Goetz, Baldwin, Gee, & Sailor, 1982; Macht, 1971; Newsom & Simon, 1977) to simplify this test for use with school aged children with various handicaps. These adaptations have reduced the number of E's presented at one time to two and require that subjects be trained to respond to the visual stimuli in only one of four possible orientations. For instance, procedures in these studies consistently include lengthy training phases and utilize motor skills, such as walking 20 feet down a path to indicate right or left placement of the correct stimulus. At present, this testing approach does not appear to hold promise for measuring acuity in the target population.

HOTV. This far-point test has a standard chart format and requires that the person being tested make discriminative responses (i.e., labelling or matching) to four letters: H, O, T, and V. Lippman (1971) has reported the test's usefulness with preschool children ages three to five. The use of a match-to-sample procedure opens up alternative response possibilities (e.g., finger point, button press, eye point) that might allow the testing of some children in the target population.

Picture cards. Examples of several tests that utilize picture cards as assessment format and measure far-point vision are: the Allen Preschool Test (Allen, 1957); the Lighthouse Flashcard Test (Faye, 1968); and the Efron Test (Mabry, 1982). Each of these instruments involves the use of single picture flashcards and requires the subject to make some type of labelling response to the targets when they are viewed at distances varying from 10 to 30 feet. The material accompanying the Lighthouse Test suggests shortening the test distance to assess children with visual impairments. The Allen Preschool Test has been shown to yield results comparable to the Snellen E test with a sample of preschool children ages three to five years with no apparent handicaps (Barker & Barmatz, 1975; Taubenhaus & Jackson, 1967; Wolf & Harvey, 1959). However, for this assessment subjects are required to label several quite stylized figures, thus, limiting the test's usefulness with the target group. Finally, Mabry (1982) does report success in testing children with mild mental retardation ages 6 to 21 years with the Efron Test.

None of the manuals for the picture card tests suggest alternatives to a verbal labelling response. But matching responses, such as those described for the HOTV Test, could be used with any of the measures. This type of adaptation would increase the usefulness of these tests with the target population. Another possible adaptation would be to present two pictures (one in each of the tester's hands) equidistant from the child being tested and to ask the child to "look at" or "point to" one of the two choices. Successful use of this procedure would require that the child's responses be discreet and that they are measured reliably by the observer. These conditions are more likely to be met if test distances of less than 10 feet are employed.

The Parsons Visual Acuity Test (PVAT). The PVAT (Cress, Johnson, Spellman, Sizemore, & Shores, 1982; Cress, Spellman, DeBriere, Sizemore, Northam, & Johnson, 1981) uses picture stimuli in a novel format accompanied by a systematic operant test procedure. Each test card presents three pictures. One of the pictures, the outline of a hand, is varied in position on the card and is always the correct choice. The stimulus card is presented to the child and the general response is to "point to the hand" or to match a small card printed with the picture of the hand with the same picture. Both near- and far-point acuities are tested, with distance testing being optically simulated.

This test was designed originally for use with children and adults with severe handicapping conditions and later was found to be useful with preschool children with various handicaps (Spellman, Cress, & Sizemore, 1982). Many aspects of the procedure reflect research findings in the areas of stimulus control and visual discrimination training. In recognition of the potential need to teach the required discriminative response, the procedure includes a set of training cards based on principles of errorless learning of visual discriminations (Sidman & Stoddard, 1966; Terrace, 1963). The PVAT has been used with a limited number of individuals who are labelled deaf-blind and several have been tested successfully for acuity. While promising, additional investigation is needed to determine whether this procedure is fully applicable to the target group.

Preferential looking. A growing body of research has resulted from the work of Fantz (1963) and others in the study of infant visual preferences. It has been found that infants consistently prefer to look at a patterned, rather than a plain or homogeneous, viewing target. This finding has important implications in the testing of children's visual capabilities. Specifically, the preferential looking paradigm, involving a two-choice visual display and a system of observation and recording, can be used to assess acuity and other visual capacities. (Preferential looking has also proven to be a valuable tool in the study of human cognition and is used extensively in developmental research. This literature has not been included in this paper, for a review of that area see Fagan and Singer, 1983.)

Visual acuity testing using the preferential looking paradigm usually involves the presentation of a black and white grating, or striped target, of various dimensions that is paired with a plain grey target of equal luminence. The capacity to detect the stripes on an otherwise plain background involves the use of resolution acuity, as opposed to the tests described previously that measure recognition acuity (i.e., the ability to either label a stimulus or discriminate it from other stimuli). While the relationship between recognition and resolution acuity is still being investigated, it appears that the two factors are correlated (r = .789 in a recent study by Mayer, Fulton, & Rodier. in press). Advantages of the resolution task include the requirement of a far less sophisticated response from the individual being assessed than in stimulus identification, and the fact that the response most often used in this assessment approach, visual fixation, is present in most humans at birth or shortly thereafter.

Preferential looking techniques for acuity testing initially employed lengthy presentations of visual stimuli of a minute or more, but were soon altered to a procedure known as forced preferential looking (FPL) (Teller, 1979). FPL procedures utilize testing trials of a few seconds, thus, facilitating the completion of the assessment. FPL has been found to be useful for most infants from birth to six months of age. Beyond six months, however, subjects are difficult-to-test due to difficulty in maintaining their interest in the task. This general finding may not be applicable to young children with developmental delays. Duckman and Elenow (1983)have found that preschool children with developmental disabilities (e.g., Down Syndrome, severe retardation, and microcephaly) maintained interest in the FPL task to much older ages than infants with no apparent handicaps.

To facilitate the visual testing of children after six months with this type of technique, Mayer and Dobson (1980, 1982) introduced a variation of FPL called operant preferential looking (OPL). The major difference between the two approaches is that OPL pairs a presumably reinforcing consequence (a multi-sensory display with lights and battery-operated toys) with the desired response of fixating on the stripes. The arrangement, modeled after a procedure described by Moore, Wilson, and Thompson (1977) for auditory testing, presents the reinforcing display on either the left or right side of the subject, depending on the location of the stripe. The OPL procedure appears quite powerful with most young children who do not respond well to standard FPL testing.

Due to the limited attention spans of young subjects, several researchers have recognized the need to minimize the number of trials per test while maintaining statistical accuracy in the assessment. Dobson (1983) proposes the use of a shortened procedure for screening purposes. Her approach, referred to as the "diagnostic grating" procedure, is based on normative PL data for infants of various ages and involves the repeated presentation of a stripe width that is known to be seen by most infants the same age as the subject. Consequently, infants whose acuities are normal for their age pass this screening while those who fail may receive more extensive testing and/or a medical referral. Mayer, Fulton, and Hansen (1982) describe a "staircase procedure" in which decreasingly smaller stripes are presented following two correct responses at each target size. Errors result in the presentation of a trial of wide suprathreshold stripes, followed by the presentation of a stripe width one size larger than that presented in the error trial. This procedure yields visual thresholds in 20 to 25 trials, not including the suprathreshold trials, and appears to have acceptable statistical characteristics. Most recently, a rapid PL test for infants has been developed by McDonald, Sebris, Mohn, and Dobson (in press) that yields acuities in an average time of less than five minutes per subject. This "acuity card" procedure allows observers to estimate acuity after repeated presentations of only four stimuli. This assessment approach is now being put through clinical trials by several investigators, including the author of this review.

While PL viewing distances vary slightly from study to study, most procedures approximate traditional near-point testing. No reports have been found of attempts to measure distance acuity through PL testing, possibly because of the difficulty of maintaining the subjects' attention to a distant target and judging left-right fixation at a distance. This problem is particularly salient if the procedure is used for the screening or assessment of older populations. School-aged children are more likely than preschoolers to have, or develop, myopia (near-sightedness) so visual screening programs for this age group should emphasize far-point acuity testing. Further, knowledge of a person's distance acuity can be useful in the design of orientation and mobility training programs, modifications of learning environments, and similar programming issues. Thus, it is apparent that in some instances the PL approach would not be appropriate.

Most of the PL acuity testing described in the literature to date has related to binocular testing. However, monocular (single eye) acuity scores are desirable for purposes of screening, diagnosis, and treatment of certain vision disorders. The need to test each eye separately accentuates the difficulties of maintaining the child's interest in the test and increases the number of thresholds necessary to gain an index of the subject's visual acuity. An additional problem in monocular testing is the need to occlude the eye not being tested, which typically requires that the subject wear an eye patch. Many young subjects vigorously resist patching, so much so that monocular acuities are sometimes unobtainable. Two suggestions that have been offered to alleviate this problem are pretraining the child to tolerate a patch (D.L. Mayer, personal communication, May, 1984), and devising a less intrusive occlusion method (J. Allen, personal communication, May, 1984).

Applications of the PL acuity test procedures to persons with developmental disabilities have recently appeared in the literature (Duckman & Selenow, 1983; Lennerstrand, Axelsson, & Andersson, 1983; Mayer, Fulton, & Sossen, 1983; Mohn & Van Hof-Van Duin, 1983). Populations in these studies include children with Down syndrome, cerebral palsy, and other developmental disabilities; adults with severe multiple handicaps; and subjects labelled "visually inattentive." In all studies it was found that the majority of the subjects were testable with the technique. Mayer Fulton, and Sossen (1983) found that PL acuity scores for subjects with developmental disabilities were poorer than expected for the subjects' ages, but that this decrement covaried with the severity of the developmental delay. They hypothesize that delays in central nervous system functioning and/or motor development account for this poorer PL performance. Interestingly, it has been shown that later neurological disorders were better predicted for infants by a PL discrimination task than by a neurological examination (Fagan & Singer, 1983).

In conclusion, the implications of PL testing for the target population should be more fully investigated. Teller (1983) has provided an excellent discussion of the current limitations and future trends in PL acuity research. In addition to the points raised by Teller, the effects of various handicaps on PL performance need further investigation, as do the effects of more individualized reinforcer selection and other procedural modifications.

Contrast Sensitivity

The healthy visual system is capable of detecting various types of contrast between two or more stimuli through various retinal and cortical functions, a capability referred to as "contrast sensitivity." The vision research literature includes mention of contrast sensitivity to several stimulus characteristics such as spatial contrast, luminence contrast, photopic contrast, and spectral contrast. Tests for contrast sensitivity have proven useful in the medical evaluation and treatment of visual disorders including amblyopia (Campbell, 1983) and those conditions involving macular and/or retinal degeneration (Hyvarinen, 1982). Until recently, though, reports of behavioral measures of contrast sensitivity did not include young children or persons with handicaps due to the complex response requirements of existing assessment procedures. New developments in infant vision research have led to a more intensive investigation of this area.

Some measures of contrast sensitivity can be obtained by the electroretinogram (ERG) and visually evolked response (VER) techniques, that were described earlier in this review, by using complex stimulus arrays (Fiorentini, Pirchio, & Spinelli, 1983). Several researchers have found it desirable to devise a behavioral measure of young subjects' contrast sensitivity. For example, Fulton and Rushton (1978) and Fulton and Hansen (1983) compared behavioral data on contrast sensitivity under dark adapted conditions (using a PL procedure similar to that described previously) to ERG data on the same subjects. Results indicate that the behavioral and electrophysiological measures are correlated for subjects with normal retinas, but are quite different when subjects with retinal pathology are examined. It is suggested (Fulton & Hansen, 1983) that behavioral measurement is more sensitive to a broader range of retinal disfunction than the ERG.

Assessment of contrast sensitivity appears to have significant educational implications for persons with visual impairment, including those in the target population. Obviously, the appropriateness of using the experimental procedures to measure contrast sensitivity with the target population will need to be investigated. Moreover, if such assessment proves feasible, it will be necessary to make efforts to incorporate this information into an educational framework. Such studies could provide answers to some of the questions raised by program planners regarding optimal viewing conditions for children who have severe visual impairment. These questions are related to ambient lighting and to stimulus form, size, color, and intensity requirements.

Visual Fields

Visual field testing has traditionally been a behavioral procedure where targets are presented at various points in the normal visual field and the person being assessed indicates when the target is seen. The detection and measurement of a field loss is critical to the appropriate medical diagnosis and treatment of certain visual impairments. Additionally, field loss can have significant implications for educational and rehabilitation programming. Consequently, recent attempts have been made to simplify the response requirements for this type of testing in both clinical and educational assessments.

Attempts to assess visual fields in a gross fashion with infants and young children, with and without developmental delays, have typically involved the manual presentation of a test stimulus from behind or to the side of the person being tested (Bayley, 1969, and Langley, 1980). The usual response is for the subject to turn to a light or object, or to locate and fixate the test target when it appears anywhere in their field. This type of peripheral vision assessment appears as a component in many child development assessment tools as well as in functional vision assessments.

Numerous problems exist with these procedures. First, it is rarely certain whether the infant or young child is fixating centrally when the test target is introduced. If the subject is not fixating centrally, it cannot be determined which portion of the field was stimulated. An additional weakness of these procedures is the difficulty in obtaining reliable observations of the subject's response by the tester located behind, or even in front of, the subject. (This author has found that the use of a frontal observer can be detrimental to testing visual fields in all but the darkest settings due to most children's visual preference for faces; many youngsters never stop fixating on the observer.) Tests using lights as targets may require that the test environment be made progressively darker if the subject fails to perform, either to reduce visual distractions or to elicit responses from persons with reduced contrast sensitivity. Unfortunately, a dark test environment aggravates the problems of reliable observation of the subject's eye movements and fixations. Finally, the manual presentation of stimuli from behind or to the side of the person being assessed often involves some gross body movement by the tester that might provide nonvisual cues to which the subject could respond.

Sailor et al. (1982) report on the use of a clinical technique for visual field assesment called the "two penlight test." This procedure calls for the presentation of one light as a central fixation target. A second light is turned on at a predetermined point in the normal visual field while the tester simultaneously turns off the central light. This technique addresses the previously mentioned problem of subject orientation by attempting to obtain central fixation prior to the introduction of the test stimulus. (Of related interest is the study by Utley, 1983, that strongly suggests that young children with severe multiple handicaps, such as those in the target group, can be trained to fixate on a light.) These researchers were able to increase the duration of their subjects' fixations by activating a multicolored light display contingent upon the subject's fixation of a single light. The Sailor et al. technique requires that users have considerable manual dexterity, precise stimulus presentation, and considerable observation skills. In addition, the procedure uses a frontal observer and is subject to the measurement problems described in the previous paragraph. Although the procedure may require a darkened test environment for those who fail to respond under standard ambient lighting conditions it should be noted that one of the penlights is on at all times, thus, alleviating some of the problems of observing the subject's eye movements in darkened environments.

Additional research is needed to develop more precise visual field assessment techniques for the target group. Areas in need of investigation include procedures for obtaining reliable responses under visual field testing conditions and the possible use of reinforcement contingencies to elicit and maintain responding during the assessment. Such effort seems warranted considering the data these assessments could provide.

Stereopsis

Stereopsis, or stereoscopic depth perception, refers to the capacity of the visual system to perceive depth under binocular viewing conditions. Tests for stereopsis are included frequently in vision screening programs since failure to develop stereopsis is indicative of unequal vision in the two eyes (amblyopia). Because stereopsis involves both visual and cortical functions, researchers have sought to determine at what age human infants develop stereopsis. Although the results of several studies differ as to the earliest ages at which stereopsis is found (e.g., Atkinson & Braddick, 1976; Fox, Asin, Shea, & Dumais, 1980), most support the conclusion that the normally developing visual system is capable of stereopsis by six months.

The measurement of stereopsis has been a major goal in some preschool and school screening programs, in an effort to detect amblyopia during the time it is most responsive to treatment. One test widely used in this context is the Stereo Fly Test (Appel & Lowry, 1959) in which a stereo photograph of a house fly is shown to the child while s/he is wearing glasses frames with one red and one green filter. Persons who have stereoscopic depth perception will perceive a three-dimentional image; i.e., the fly will appear to be above the surface of the test book. The test requires a fairly simple motor response (touching or pinching the fly's wings above the test book), but comprehension of the test's verbal instructions requires rather complex receptive language. Therefore, the measure is often unreliable with preschool children younger than three years old who are nonhandicapped. Another drawback in using this test with any young population is the resistance of many children to the wearing of the red-green glasses. Since this test requires responses beyond those commonly found in the target population, and it intended only for screening purposes, it would appear to have limited value for the target group.

Another widely-used test for stereopsis screening is the Wirt Stereotest (Appel & Lowry, 1959). In this test an ordinary flashlight with an attached filter, with four circular holes or dots, is used. The person being tested wears red-green glasses while viewing the four-dot target and must point to each dot. Since the dots are color coded to correspond to the filters of the red-green glasses lack of stereopsis, or failure to use both eyes equally, results in seeing less than--and occasionally more than--four dots. This test can also be used if information on eye dominance is desired. For example, the person being tested must point to all of the green dots, then repeat the exercise for the red dots. One of the test dots is white, or blank, and can be perceived as either red or green depending on the dominant eye. The Wirt Stereotest requires receptive language skills and either a motor (point) or a verbal response. However, the simplest response, that of touching the dots, can be performed by most children 18 months or older (T. Lawwill, personal communication, September, 1984). Resistance to the red-green glasses remains a problem with this procedure. Further, the test's primary use, as a screening tool, would appear to limit its usefulness with the target group to that of early detection of visual impairment. No studies were found which explored the potential use of this test to monitor change in stereopsis due to maturation or a planned intervention.

A new procedure for testing stereopsis in infants has been described by Fox et al. (1980). This procedure utilizes a random-dot stereogram target presented on a color television screen. The dots, both red and green, were randomly "replaced" 60 times per second. This display, when viewed through red-green glasses, was known to result in the perception of a moving rectangle form by adults with stereopsis. The response, tracking the moving rectangle, was tested for use with young children. The procedure involves a human observer to judge whether the infant tracks the rectangle and in what direction. Once it is determined that the infant consistently tracks the pretest form, stereopsis is measured using the random-dot stereogram in 10 to 40 trials (depending on the attentiveness of the infant being tested).

Several features of this procedure may have implications for the target group. The response of tracking a moving target is likely to be present in all but the youngest or most severely visually impaired individuals. The procedural step of pretesting the desired response would assure that actual test results are not confounded by the subject's response limitations. And, although the generation and display of the stereogram stimuli requires a computer and television receiver this equipment is becoming increasingly available in educational settings.

As noted by Fox et al. (1980) their procedure could be valuable in the early detection of vision problems. Unfortunately, applications of this test for persons with known visual impairment seems quite limited. Most children considered to be blind would not be expected to have good stereopscopic depth perception and the type of result yielded by this procedure (presence or absence of stereopsis) does not appear to have major implications for program planning for the target group. Other applications of the stereogram target have been investigated by Fox and his colleagues (Fox, Lehm, Kuhle, & Lequire, 1978; Fox, Patterson, & Francis, 1984). For the present, though, the assessment of stereopsis, while frequently used in traditional vision screening programs, does not seem to have significant applications to the target population of young children with known visual impairment. Continued efforts to refine the techniques employed could result in an effective tool for screening infants and, subsequently, could result in earlier identification of visual problems for members of the target group.

Summary

There has been impressive growth in the past ten years in the amount of research in vision assessment. It appears that methodology now exists to detect abnormal visual devlopment, and/or determine the nature and extent of most visual impairments, in children at younger ages than ever before. What is needed, though, is to further investigate the application of the more promising procedures described herein with the target population.

Many of these procedures will need to be adapted for use with the target group. In particular, allowance will need to be made for the limited response repertoires of these children. For example, children described as "visually inattentive" may need to be trained to perform the required visual behavior. Both Utley (1983) and Mayer et al. (1983) have shown that such children can often be trained to visually fixate a target using contingent reinforcement. In a related vein, Cress et al., 1982, found that many children with multiple handicaps who were initially unable to respond to their acuity test procedure could, with limited training, acquire the necessary response. An approach that is quite responsive to individual response repertoires has been described by Brinker and Lewis (1982). These investigators observed their young subjects with various handicaps and noted what movements the children demonstrated; from these, discrete responses were selected on a subject-by-subject basis. The flexibility of this technique appears to warrant further investigation for possible application to the assessment of vision. Finally, while several of the reported procedures are described as using operant conditioning techniques, little variation was found in the choice of presumably reinforcing events. As with the selection of the responses, the selection of reinforcing consequences may need to be more individualized if such procedures are to be useful with the target group.

References

Allen, J. F., (1957). Testing visual acuity in preschool children: Norms, variables, and a new picture test. Pediatrics, 19, 1093-1100.

Atkinson, J., & Braddick, O. (1982). The use of isotropic photorefraction for vision screening in infants. Acta Ophthalmologica, (Suppl. 157), 36-45.

Apell, R. J., & Lowry, R. W., Jr. (1959). Preschool vision. St. Louis: The American Optometric Association, Inc.

Baraldi, P., Ferrari, F., Fonda, S., & Penne, A. (1981). Vision in the neonate (full-term and premature): Preliminary result of the application of some testing methods. Documenta Ophthalmologica, 51, 101-112.

Barker, J., & Barmatz, H. (1975). Eye function. In W. Frankenburg & B. Camp (Eds.), Pediatric Screening Tests. Springfield, IL: Charles C. Thomas Publishing.

Barraga, N. (1970). Visual efficiency scale. Louisville, KY: American Printing House for the Blind.

Bayley, N. (1969). Bayley scales of infant development: Manual. New York: The Psychological Corporation.

Braddick, O., & Atkinson, J. (1982). The development of binocular function in infancy. Acta Ophthalmologica. (Suppl. 157). 27-35.

Brinker, R. P., & Lewis, M. (1982). Contingency intervention. In J.D. Anerson (Ed.), Curricula for high-risk and handicapped infants. Chapel Hill, NC: TADS.

Campbell, F. W. (1983). Why do we measure contrast sensitivity? Behavioural Brain Research, 10, 87-97.

Carr, R. E., & Siegal, I. M. (1982). Visual electrodiagnostic testing: A practical guide for the clinician. I.M. Williams & Wilkins.

Costello, K. B., Pinkney, P., & Scheffers, W. (1982). Visual functioning assessment tool. Catalog No. 33760M Testing Manual. (Available from Stoelting Company, 1350 S. Kostner Avenue, Chicago, IL 60623).

Cress, P. J., Johnson, J. L., Spellman, C. R., Sizemore, A. C., & Shores, R. E. (1982). The development of a visual acuity test for persons with severe handicaps. Journal of Special Education Technology, V, 11-19.

Cress, P. J., Spellman, C. R., DeBriere, T. J., Sizemore, A. C., Northam, J. K., & Johnson, J. L. (1981). Vision screening for persons with severe handicaps. The Journal of the Association for the Severely Handicapped, 6, 41-50.

Dayton, G. O., Jones, M. H., Aiu, P., Rawson, R. A., Steele, B., & Rose, M. (1964). Developmental study of coordinated eye movements in the human infant. Archives of Ophthalmology, 71, 865-870.

Dobson, V. (1983). Clinical applications of preferential looking measures of visual acuity. *Behavioral Brain Research*, *10*, 25-38.

Dobson, V. & Teller, D. Y. (1978). Visual acuity in human infants: A review and comparison of behavioral and electrophysiological studies. *Vision Research*, *18*, 1469.

Dubowitz, L., Mushin, J., Morante, A., & Placzek, M. (1983). The maturation of visual acuity in neurologically normal and abnormal newborn infants. *Behavioral Brain Research*, *10*, 39-45.

Duckman, R. H., & Selenow, A. (1983). Use of forced preferential looking for measurement of visual acuity in a population of neurologically impaired children. *American Journal of Optometry & Physiological Optics*, *60*(10), 817-821.

Fagan, J. F. III, & Singer, L. T. (1983). Infant recognition memory as a measure of intelligence. *Advances in Infancy Research*, *II*, 31-78.

Fantz, R. L. (1963). Pattern vision in newborn infants. *Science*, *140*, 296-297.

Faye, E. E. (1968). A new visual acuity test for partially-sighted nonreaders. *Journal of Pediatric Ophthalmology*, *5*, 210-212.

Fewell, R. R. (1983). Assessment of visual functioning. In B. Bracken & K. Paget (Eds.), *The psychoeducational assessment of preschool children*. New York: Grune & Stratton.

Fiorentini, A., Pirchio, M. & Spinelli, D. (1983). Development of retinal and cortical responses to pattern reversal in infants: A selective review. *Behavioral Brain Research*, *10*, 99-106.

Fox, R., Lehmkuhle, S. W., & Lequire, L. E. (1978). *Vision Research*, *18*, 1189.

Fox, R., Aslin, R. N., Shea, S. L., & Dumais, S. T. (1980, January). Stereopsis in human infants. *Science*, *107*(18), 323-324.

Fox, R., Patterson, R., & Francis, E. L. (1984). *Stereoacuity in young children*. Paper presented at The Association for Research in Vision and Ophthalmology Incorporated, Sarasota, FL.

Fulton, A. B., & Hansen, R. M. (1983). Retinal sensitivity and adaptation in pediatric patients. *Behavioral Brain Research*. *10*, 59-70.

Fulton, A. B., Hansen, R. M., & Manning, K. A. (1981). Measuring visual acuity in infants. *Survey of Ophthalmology*, *25*(5), 325-332.

Fulton, A. B., & Rushton, W. A. H. (1978). The human rod ERG. Correlation with psychophysical responses in light and dark adaptation. *Vision Research*, *18*, 793-800.

Gates, C., Berry, C. S., & Reid, M. (1979). *Revised manual for visual assessment kit*. Unpublished manuscript, University of Northern Colorado.

Goetz, L., Gee, K., Baldwin, M., & Sailor, W. (1982). Classroom-based sensory assessment procedures for severely handicapped students: Case studies of a stimulus transfer paradigm. *Analysis and Intervention in Developmental Disabilities*, *2*, 171-185.

Gorman, J. J., Cogan, D. G., & Gellis, S. S. (1957). An apparatus for grading the visual acuity of infants on the basis of opticokinetic nystagmus. Pediatrics, 19(6), 1088-1092.

Howland, H. C., & Sayles, N. (1983). Photorefractive studies of normal and handicapped infants and children. Behavioral Brain Research, 10, 81-85.

Hyvarinen, L. (1982). Contrast sensitivity in visually impaired children. Acta Ophtholmologica, 157, 58-62.

Kaakinen, K. (1979). A simple method for screening of children with strabismus, anisometropia or ametropia by simultaneous photography of the corneal and the fundus reflexes. Acta Ophthalmologica, 57, 161-171.

Langley, M. B. (1980). Functional vision inventory for the multiple & severely handicapped. Cat. No. 33856. (Available from Stoelting Company, 1350 S. Kostner Avenue, Chicago, Il 60623).

Lawwill, T. (1971). Electrodiagnostic techniques in ophthalmology. The Journal of the Kentucky Medical Association.

Lennerstrand, G., Axelsson, A., & Andersson, G. (1983). Visual acuity testing with preferential looking in mental retardation. Acta Ophthalmologica, 61, 624-633.

Lippman, O. (1971). Vision screening of young children. American Journal of Public Health, 61(8), 1586-1601.

McDonald, M., Sebris, S. L., Mohn, G., & Dobson, V. (in press). Monocular acuity in normal infants: The acuity card procedure. Investigative Ophthalmology and Visual Science.

Mabry, L. W. (1982). A study of visual acuity testing among educable mentally handicapped and trainable mentally handicapped. Unpublished doctoral dissertation, University of South Carolina - Columbia.

Macht, J. (1971). Operant measurement of subjective visual acuity in non-verbal children. Journal of Applied Behavior Analysis, 4, 23-36.

Mayer, D. L., & Dobson, V. (1980). Assessment of vision in young children: A new operant approach yields estimates of acuity. Investigative Ophthalmology and Visual Science, 19, 556-570.

Mayer, D. L., & Dobson, V. (1982). Visual acuity development in infants and young children as assessed by operant preferential looking. Vision Research, 22, 1141-1151.

Mayer, D. L., Fulton, A. B., & Hansen, R. M. (1982). Preferential looking acuity obtained with a staircase procedure in pediatric patients. Investigative Ophthalmology and Visual Science, 23(4), 538-543.

Mayer, D. L., Fulton, A. B., & Rodier, D. (in press). Grating and recognition acuities of pediatric patients. Ophthalmology.

Mayer, D. L., Fulton, A. B., & Sossen, P. L. (1983). Preferential looking acuity of pediatric patients with developmental disabilities. Behavioral Brain Research, 10, 189-198.

Mohn, G., & Van Hof-Van Duin, J. (1983). Behavioral and electrophysiological measures of visual functions in children with neurological disorders. *Behavioral Brain Research*, *10*, 177-187.

Moore, J. M., Wilson, W. R., & Thompson, G. (1977). Visual reinforcement of head-turn responses in infants under 12 months of age. *Journal of Speech Hearing Disorders*, *42*, 328-334.

Newsom, C. D., & Simon, K. M. (1977). A simultaneous discrimination procedure for the measurement of vision in nonverbal children. *Journal of Applied Behavior Analysis*, *10*, 633-644.

Rock, Litchfield, Jans, Schulz, Ulrich, Pray, & Vedovatti. (1983). In V. Kennedy (Ed.), *Vision and Hearing Screening of the Severely Handicapped: A Resource Guide*. Phoenix: Arizona Department of Education.

Sailor, Utley, Goetz, Gee, & Baldwin. (1982). *Vision assessment and program manual for severely handicapped and/or deaf-blind students.* San Francisco State University: Bay Area Severely Handicapped Deaf Blind Project, U.S. Department of Education, Contract #300780038.

Sidman, M., & Stoddard, L. T. (1966). Programming perception and learning for retarded children. In N. R. Ellis (Ed.), *International review of research in mental retardation* (Vol. II). New York: Academic Press.

Sokol, S. (1976). Visually evoked potentials: Theory, techniques and clinical applications. *Survey of Ophthalmology*, *21*(1), 18-44.

Sokol, S. (1980). Pattern visual evoked potentials: Their use in pediatric ophthalmology. *International Ophthalmology Clinic*, *20*, 251-268.

Spellman, C. R., Cress, P. J., & Sizemore, A. C. (1982). *Final report from research and development of subjective visual acuity procedures for handicapped preschool children* (Grant #G00-79-01961). Washington, D.C.: U.S. Department of Education, Office of Special Education.

Stangler, S. R., Huber, C. J., & Roth, D. K. (1980). *Screening growth and development of preschool children: A guide for test selection.* New York: McGraw-Hill.

Taubenhaus, L. J., & Jackson, A. A. (1967). *Vision screening of Three Through Five Year Old Children.* (Final Report, Grant #N2301). Brookline, MA Health Department: National Center for Chronic Disease Control, United States Public Health Service.

Teller, D. Y. (1979). The forced-choice preferential looking procedure: A psychophysical technique for use with human infants. *Infant Behavior Development*, *2*, 135.

Teller, D. Y. (1983). Measurement of visual acuity in human and monkey infants: The interface between laboratory and clinic. *Behavioral Brain Research*, *10*, 15-23.

Terrace, H. S. (1963). Discrimination learning with and without errors. *Journal of the Experimental Analysis of Behavior*, *6*, 1-27.

Von Bargen, D. M. (1983). Infant heart rate: A review of research and methodology. *Merrill-Palmer Quarterly*, *29*, 115-149.

Wolfe, P. (1979). A case in point: Utilizing the visul evoked response (VER) for visual fields when subjective responses are not attainable. *Journal of the American Optometric Association*, *50*, 117-118.

Wolfe, W. G., & Harvey, J. E. (1959). *The evaluation and development of techniques for testing the visual acuity of trainable mentally retarded children.* (Project #172 6447). Washington, D.C.: United States Department of Health, Education, and Welfare, Office of Education.

SCC90

IV. Auditory Evaluation

Joseph E. Spradlin

Infants and children who are suspected of being deaf and blind present major evaluation problems. These problems are often stated as a series of questions such as: "Does the child hear anything?" "Is failure to respond to auditory stimuli a function of peripheral sensory problems or is it a function of more central neurological problems?" "To what degree are the hearing problems correctable through medical treatment and/or prosthetic devices?" "What are the best modes to use for communicating with and teaching the child?" All of these questions are very important and practical. In general these issues seem to fall into two general classes--questions that are important for medical management and treatment, and questions that are important to educational management and intervention. Since the purposes for hearing evaluation are somewhat different for people charged with medical management than for those charged with educational management, different procedures may prove maximally useful in the two areas. For example, procedures that would isolate tumors, middle ear infections, or specific neurological lesions would be extremely useful for medical management. However, if these procedures did not provide information concerning clients voluntary responses to auditory stimuli, those procedures might have little use in educational management. Conversely, if procedures provide information concerning the client's ability to respond to various types and levels of auditory stimuli, they would be very useful for developing educational procedures. But, if information concerning the morphology of the auditory system is not provided, the measures may have little use in medical management.

The following review summarizes procedures for evaluating hearing among infants and children who are difficult to test. The report is divided into three major sections: immittance audiometry, evoked potential audiometry, and behavioral audiometry. In each section there is a brief overview of the procedures, an evaluation of their potential for evaluating difficult-to-test persons, and a discussion of the limitations and benefits of each technique.

Immittance Audiometry

Immittance audiometry refers to a set of procedures that evaluate the condition of the audiological system through measurement of changes in the position of the tympanic membrane as a function of different levels of air pressure in the ear canal and the reflexive response of the tensor tympanic muscle. These procedures are especially useful in detecting fluid in the middle ear and abnormalities of the occicles. Static compliance, tympanography. and acoustic reflex evaluation constitute the three main measurements of immittance audiometry (Orchik & MacKimmie, 1984).

Static Compliance

Static compliance is an assessment approach that evaluates the compliance of the middle ear system. It is usually expressed in terms of volume air (in centimeters squared) under two conditions --one with positive pressure equal to 200 millimeters of water at the tympanic membrane, and the second with the membrane in its most compliant point (Northern & Downs, 1978, p. 158). Since the static compliance measure is based on the volume of air made at only two pressure values, it provides limited information and is considered by Orchik and McKimmie (1984) to be the least useful of the three immittance measures. Jerger (1980) reported that the measure yielded a high percentage of false positives when used with children to detect otitis media.

Tympanography

Tympanography provides a measure of the relative change in compliance in the external ear canal as air pressure is varied in that passage (Orchik & MacKimmie, 1984). Since air pressure is varied across a wide range, the measurement gives a good picture of the compliance of the tympanic membrane. Tympanography is one of the most effective procedures for detecting effusion associated with otitis media. In a comparison of tympanography with standard puretone audiometry Bluestem, Berry, and Paradise (1973) evaluated 34 children with both tympanography and puretone testing. They found that of 34 children who had puretone thresholds of better than 25 decibels (dB) Hearing Threshold Level (HTL), 16 had serious otitis media when they were subjected to myringotomy. All of these 16 subjects had abnormal tympanograms and eight of these children had puretone thresholds better than 15 dB (HTL). Thus, it is clear that normal puretone threshold does not rule out severe otitis media, but normal tympanograms do rule out severe otitis media.

Of course, the utility of tympanography is not limited to children with otitis media. It will be responsive to any abnormality of the middle ear that results in changes in compliance of the tympanic membrane--these include interruption of the ossicles, frozen ossicles, middle ear tumors, and perforated tympanic membranes. It is clear, then, that tymponagraphy is a valuable tool for the detection and medical management of problems of the middle ear.

Acoustic Reflex Thresholds

Acoutic reflex thresholds "represent the minimum intensity that will result in detectable reflexive contraction of the stapedial muscle" (Orchik & MacKimmie, 1984). Both puretones and broad-band signals have been used for testing. If the middle ear is normal the inability to obtain an acoustic reflex indicates a sensorineural loss. Typically the procedure for evaluating sensorineural loss is based on the difference between the threshold obtained with puretones and the threshold obtained with broad-band noise. In general, the smaller the difference between these two thresholds the greater the likelihood of a sensorineural loss (Jerger, Hayes, & Anthony 1978). However, some researchers have used absolute threshold for broad-band noise, and the acoustic reflex is quite accurate in predicting sensorineural loss in children between 2 to 12 years of age.

Whether the acoustic reflex is useful for evaluating infants younger than age two is another matter. Abahazi and Greenberg (1977) reported on the tests for the acoustic reflex with 62 infants from 1 to 12 months of age. Only 23 of the infants demonstrated the acoustic reflex for white noise, 500 hertz (Hz), 1000 Hz, and 2000 Hz tones. On the other hand, Gerber, Gong, and Mendel (1984) reported that they tested 45 infants between 12 to 36 weeks and all subjects yielded acoustic reflexes. Specifically, acoustic reflexes occurred at an average level of slightly above 70 dB for a broad-band noise and at about 80 dB for 4000 Hz tones. The procedures of these studies are not described in sufficient detail to determine the source of the difference. One could conclude, based on the data, that if an acoustic reflex is obtained from an infant to the 500 Hz, 2000 Hz and 4000 Hz tones, that infant has normal hearing. The absence of such reflexes under one year of age may or may not indicate a hearing deficit.

Implications for the Target Population

Immittance audiometry appears to have its greatest use in detecting middle ear pathology. Tympanography is an established procedure for detecting pressure in the middle ear caused by otitis media. For that reason it is extremely useful in detecting middle ear pathologies and making referral to otologists for medical management. Unfortunately, the utility of tympanometry for educational management is more limited since it gives limited information on the hearing of the client. Because the same apparatus is used for evaluating the acoustic reflex as is used in tympanography, it is cost and time effective to test for sensorineural losses concurrently with obtaining a tympanogram. However, if the child does have middle ear pathology, failure to obtain an acoustic reflex may have little meaning. Immittance audiometry depends on placing a plug in a child's ear and obtaining a tight seal; thus, it depends somewhat on having a cooperative child. Prior to one year of age, immittance audiometry is probably not feasible as a quick screening procedure.

Evoked Potential Audiometry

Evoked potential audiometry is based upon the fact that surface electrodes can be attached to various locations on the head and electrical potentials from the brain recorded. If an auditory or visual stimulus is presented repeatedly and the potentials following each stimulus presentation are summed and averaged, waves of positive and negative potential begin to occur at varying periods after the stimulus presentation. Investigators have studied the waves occurring during various periods after the stimulus presentation. The first investigators of evoked potentials studied waves occurring from 50 milliseconds up to over one second after stimulus presentation (late components). Later investigators have studied waves between 0 and 10 milliseconds after stimulus presentation (early). Stimulus presentations have ranged from one stimulus per second up to over 100 stumuli per second.

Auditory Brainstem Response

The most widely used evoked potential procedure is termed Auditory Brainstem Response (ABR). It involves analysis of the first 10 milliseconds of brainstem responses following stimulus presentation. The first 10 milliseconds of activity presumably involve brainstem potential. Generally, analysis of the first 10 milliseconds of activity has resulted in five waves (I, II, III, IV, V). For most diagnostic work the latency between waves I and V has been used. Onset of waves I and V in a child varies with age; however, by about one year of age, the wave forms of infants closely approximate those of normal adults (Salamy & McKean, 1976). Since waves I and V are present in newborns with no apparent handicaps (although late relative to adults who are not handicapped), brainstem audiometry is viewed as a technique with great value for evaluating the auditory system of very young and severely handicapped children (Hecox, Gerber, & Mendel, 1983; Jerger, Hayes, & Jordan, 1980). Brainstem audiometry is also insensitive to medication, sleep state, and even anesthesia and hence requires little or no subject cooperation.

Jerger, Hayes, and Jordan (1980) reported on their use of ABR on 167 children who were between 4 days and 83 months of age. The subjects were referred by otolaryngologists, audiologists, pediatricians, neurologists, school districts, centers for the multiply handicapped, and university speech and hearing clinics. Of the 167 children, 136 required sedative medication for evaluation. The most frequently used medication was chloral hydrate. In a small number of cases, though, chloral hydrate was used with demoral, phenergran, and thorazine. Within the sample were 31 children with such neurological problems as cerebral palsy, Down Syndrome, cerebral atrophy, hydrocephalus, microcephaly, and seizure disorders. Of these children nine (30%) gave no ABR at 90 dB HTL and eight children yielded ABR thresholds between 50 and 90 dB. The authors interpreted these results as ruling out severe peripheral losses for the 14 children who obtained ABR thresholds between zero and 40 dB. They concluded that the results for the remaining subjects were ambiguous because their lack of ABRs may have been due to a peripheral hearing loss and/or a neurological disorder. However, cross checks with impedance audiometry and behavioral audiometry showed perfect agreement on the subjects who yielded no ABR even to the 90 dB HTL signal. The fact that the results of the ABR testing impedance audiometry and behavioral audiometry were so closely related suggests that the ABR procedure will be useful even with those clients on whom it is impossible to obtain valid behavioral audiometric or impedence data.

In addition to providing information relative to peripheral hearing intactness, ABR can provide diagnostic information regarding white matter neurological disorders. A lengthened interpeak duration is associated with abnormal nerve myclinization that occurs with phenylketenuria and maple syrup urine disease.

Cortical Auditory-Evoked Potentials

Cortical auditory-evoked potentials (AEP) involve an evaluation of waves between eight and 50 milliseconds. Like the brainstem responses, the cortical evoked response waves are largely unaffected by sleep or medication (Mendel & Goldstein, 1971). Unlike brainstem evoked responses, though, the AEP waves are diminished by complete anesthesia (Goff, Allison, & Lyons, 1977, reported in Mendel, 1983).

Robier, Lemaire, Garreau, Ployet, Martineau, Delvert, and Reynaud (1983) reported on the use of ABR and AEP evaluation of 24 difficult-to-test children between 2 to 14 years of age. Of these children, five showed no reproducible waves at 90-100 dB HL. One child demonstrated I and V waves, but showed increased latency between the I and V waves. Eighteen children showed normal I and V waves and normal latencies between I and V. The five subjects who showed no reproducible waves were inferred to have profound bilateral sensorineural losses. When AEPs were evaluated for the 24 children, 10 showed normal or near-normal AEP waves. Four children showed the absence of P1 waves but otherwise the AEP waves appeared normal. Ten children showed so much variability that the different AEP waves were unidentifiable. Of the five children who showed no ABR, none showed responses on the AEP. The subjects who showed a prolonged latency on the ABR also showed no AEP. Of the 18 subjects who showed normal ABR, 10 showed normal AEP and eight showed either no responses or pathological AEP responses.

Later Auditory Evoked Potential Evaluation

The early work on auditory evoked potentials consisted largely of evaluation wave forms occurring beyond 50 milliseconds; however, these wave forms were affected by a variety of conditions such as sleep state or medication. For such reasons, these later components have proven impractical for auditory evaluation.

Implications for the Target Population

In recent years, the ABR has achieved great popularity among audiologists who test infants and severely handicapped children because it requires no cooperation from the client and yields reliable data even on newborn infants. Moreover, it allows for differential diagnosis of conductive and sensorineural losses in many cases.

Occasional problems have been encountered with this procedure. For example, a limited number of children who have no sign of ABR, even at high intensity tones, may show normal or near-normal puretone thresholds on behavioral audiometry (Worthington & Peters, 1984). An additional limitation on the utility of ABR is the requirement of sedation. This limits the use of ABR to settings in which the subject can be medically managed. Third, evolked potential equipment is still somewhat expensive and may be limited to those settings that provide comprehensive evaluation. ,Fourth the results obtained by Robier, et al (1983), suggest that more children will show pathology on AEP evaluation than on ABR evaluation. Exactly what abnormal AEPs mean when normal ABRs are found is unknown. Also, evoked potential equipment is expensive, which further limits its availability and use. Finally the AEP, like the ABR, requires medication and hence is limited to medical settings.

In view of: a) the questionable relation between auditory evoked potentials and a person's ability to voluntarily respond to an auditory stimulus, b) the requirement of medical surveilance, and c) the expense, auditory evoked potential evaluation would seem most useful in medical management and research. Its implications for educational management are yet to be determined.

Behavioral Audiometry

Behavioral audiometry is used in this discussion to refer to any of a variety of procedures in which a sound is presented and the subject's behavior is recorded either mechanically or by an observer. Behavioral audiometry may involve capitalization on a basic reflex, classical conditioning, operant conditioning, or--in some cases--may be based on a combination of all of these basic behavioral processes.

Traditional Procedures

The most commonly used behavioral audiometry procedure is standard puretone testing. In this technique, the audiologist verbally instructs the client that tones will be presented and that the client should tell the audiologist when he/she hears the tone. This procedure, of course, works well with clients who understand verbal instructions, but will be of little use in evaluating clients suspected of having deaf-blindness.

Another technique for evaluating the hearing of children is play audiometry. This procedure involves modifications of standard puretone audiometry so that the child is given a specific play response, such as putting on a ring on the peg each time a tone is presented. The audiologist may verbally instruct the child concerning the rules of the game, or may simply present the tone and put the child through the expected response. After the child completes the response when the tone is presented, audiometric testing may proceed. The play audiometry procedure may be useful with older children suspected of being deaf and blind, but it requires behavior that infants and many of the more severely handicapped children simply don't exhibit.

Behavioral observation constitutes the presentation of a noise and then observing whether the infant or child makes any response to that noise. Usually, if the noise is loud (90 dB+) the first time it is presented to an infant or child, there will be a startle reaction. In an infant lying in a supine position, that reaction may take the form of a Moro reflex. That is, almost immediately after the noise is presented the infant will extend its arms and then bring them in to his/her chest. The response may take the form of a jerking movement, change in facial expression, and widening of the eyes.

If the young child or infant is in an active state, the response may constitute a cessation of activity for a brief period of time.

There is little doubt that normal infants show reactions to loud sounds at, or soon after, birth and that normal hearing children continue to respond to sounds. However, the topography of the response is so varied across infants, and even within the same infant across time, that obtaining reliability of observation of reactions has been the subject of considerable concern (Bench, Collyer, Mentz, & Wilson, 1976a, 1976b). Ling, Ling, and Doehring (1979) conducted a careful study on the use of behavioral observation with neonates. They presented three different sound stimuli (narrow-band centered around 2000 Hz, 3150 Hz) and variable 2000 to 4000 Hz tone at narrow-band centered around 85 dB SPL. One observer's ears were masked so that he could not hear when the tones were being presented. The other observer could hear the tones. The observer who was masked reported more false-positive responses (responses when no tone had been presented) than the unmasked observer. The authors also reported that within three presentations of the same stimulus, the response began to adapt so that the initial stimuli could be expected to evoke a response for only a few times prior to habituation. Additionally, the intensity level of the stimulus has to be quite high (above 80 dB SPL) to evoke an observable response under most conditions. In short, behavioral observations may be useful in telling whether or not a child is deaf, but it yields little reliable information of use either for medical or educational management.

Audiometric Procedures Based on Conditioning

Application of operant and respondent conditioning principles enable behavioral auditory evaluations of handicapped children who simply can't be evaluated with traditional behavioral methods. Some of the specific applications of these principles to the hearing evaluation of such children are described below.

Tangible Reinforcement Operant Conditioning Audiometry (TROCA). This procedure is based on the use of a change in sound as a discriminative stimulus in the presence of which a button press response is followed by delivery of a bit of food, drink of liquid, or other potential reinforcer (Lloyd, Spradlin, & Reid, 1968). The procedure involves teaching the client to press a button each time the auditory stimulus changes by the immediate delivery of a reinforcer. If the client presses the button after the auditory stimulus change, a chime rings, a food receptacle lights up, and the reinforcer is delivered. If the child presses the button when an auditory change has not occurred nothing happens except that the onset of the auditory change is precluded for three to five seconds following the response. TROCA was initially developed to evaluate moderately and severely retarded clients who were untestable with nonoperant behavioral techniques. When used properly, the technique proved effective with over 90% of the severely retarded ambulatory clients tested.

The testing method has a number of advantages over other behavioral audiometric procedures. First, since the discriminative stimulus is a change in a constant stimulus, it allows for obtaining thresholds for puretones and detection of small increases in intensity on a tone baseline (Small Increment Sensitivity Index--SISI), in gaps in tones, or in any other discrete change in the sound field (Fulton & Spradlin, 1972; Fulton & Waryas, 1974). It can be used for free-field testing, with ear phones or with bone conduction. Since TROCA allows for repeated evaluation using the same basic response (i.e., signal presentation and reinforcers) it provides a means for completing rather comprehensive hearing evaluations as well as for monitoring hearing performance across time. The procedure's disadvantages are that it: a) requires, in addition to an adequate signal generator, a specific response apparatus and reinforcement delivery apparatus that are somewhat bulky and may not be readily available; b) may require extensive pretraining for 10 or more sessions to establish stimulus control for severely retarded persons; and c) is limited to subjects who have adequate motor responses and is not useful for even normal infants below 7 to 9 months of age.

Audiometry using sound localization. Turning one's eyes or head toward the source of a sound is a very primitive response. Such sound localization responses occur in newborn infants, but the reliability of these responses is low. By 4 to 5 months of age, reliable eye movement or head turning responses toward the source of complex sounds do occur (Clifton, Morrongiello, Kulig, & Dowd, 1981). In the Clifton et al. study there was no visual stimulus associated with either the presentation of the sound or the response of the child, and only a limited number of stimulus presentations occurred (12 in one study, 16 in a second study). The early neonatal localization responses are probably innate reflexes that are adaptive not only to human infants but also to lower organisms. By the time a human infant is 4 to 5 months old, the localization response is probably partially under operant control. Suzuki and Ogiba (reported in Wilson & Thompson, 1984) introduced a procedure in which a pure tone was introduced at 30 to 40 dB above the child's estimated threshold, then one second later an illuminated doll was presented in the same location as the sound source. The tone and visual stimulus both remained on for four seconds. After a few presentations, the visual stimulus was delayed and presented only after the head turn response. This procedure proved successful in obtaining threshold estimates on over 80% of children between 1 to 3 years of age. Successful threshold estimates were determined on less than 50% of the children under one year of age. Wilson, Thompson, and their colleagues have refined the procedure for visually reinforcing a head turning response toward a sound source and report fairly reliable responding to puretones with normal children as young as five months. They report the presentation of a variety of complex visual stimuli contingent on head turning toward the source of a sound, including a dancing bear and other animated toys.

Recently, Goetz, Gee, and Sailor (1983) reported a procedure using visually reinforced localization responses for multiply handicapped children. In their procedure they present a flashing light to the subject and note whether the subject turns toward the light. They then begin conditioning by presenting a sound and the light simultaneously and, then, initiate a gradual delay in the onset of the light. On some occasions probe trials are presented in which only the sound occurs. If the subject turns toward the sound source on a probe, the flashing light is presented as well as social reinforcement and tangible reinforcers. Systematic data demonstrating the success of the procedure has been presented for three multiply handicapped children.

The advantage of sound localization with visual reinforcement procedures for evaluating hearing is that it capitalizes on a natural response--i.e., eye glance or head turning. Moreover, the visual reinforcer is a natural reinforcer so the possibility for rapid conditioning seems likely. The procedure is useful with normal children as young as five months. The disadvantages of the procedures are: a) a system is required for operating visual reinforcers, and the visual reinforcers themselves; b) visual reinforcers may lose their effectiveness after repeated trials; c) some infants with severe visual problems may not be reinforced by visual stimuli; and d) reflexes or responses that may be well developed in normal children may not appear in severely handicapped children.

Uses of vibration. Since it is possible that blind children may not respond to a visual stimulus, it seems that a tactile stimulus might prove useful as a reinforcer for a head turning response toward the source of a tone. Specifically, the first step in the procedure would be to place a vibrator against one of the child's cheeks and then activate it. If the instrument proved reinforcing, the child would be shaped to turn his/her head toward the vibrator when touched on the cheek, after which it would be activated. Once the client reliably turns his/her head in response to the touch, a sound could be paired with the touch and then the touch faded in intensity or duration until the head turn was under the control of the sound alone. As in the Goetz et al. procedure, the vibrator could be accompanied by social and/or tangible reinforcers.

Frisina (1962) presented a procedure that initially used a bone-conduction vibrator as the discriminative stimulus in play audiometry. First he presented the vibrator on the back of the child's hand. After the vibration was presented, the child was prompted to put a ring on the peg when stimulated with the vibrator, the vibrator was placed on the child's forehead. The child was then tested at octave intervals through 4000 Hz. After bone-conduction testing, a puretone air conduction was administered. Generalization of control to air conduction was reported to occur reliably. According to Frisina, this procedure is adaptable for children with mental ages as young as 22 months who will accept earphones. While the Frisina procedure may not meet the requirements for evaluating severely handicapped or young deaf and blind children, the use of a vibrator stimulus and the shift of control from that stimulus to an auditory stimulus deserves exploration.

Auditory stimuli as reinforcers. Auditory stimuli may function as eliciting and discriminative stimuli, and can also function as reinforcing stimuli. Friedlander (1968) presented various vocal stimuli contingent on knob pressing responses for young children (11 to 15 months old) and demonstrated that certain auditory stimuli could increase rate of knob-pressing responses over other stimuli. Clearly, if an infant increases responses when auditory stimuli are presented contingent on those responses, the infant must hear those stimuli. Moreover, if the child reliably makes more responses when certain vocal stimuli are presented than others it can be assumed that the subject is discriminating among those stimuli.

Other investigators (Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Morse, 1974) have investigated a non-nutritive high-amplitude sucking response under various conditions in which contingent auditory stimuli were presented. Typically, the infant is presented a pacifier-like nipple. After a baseline of responding is established a brief (less than 1 second) auditory stimulus is presented each time the infant sucks at a specified intensity. Rate of sucking often increases. If rate increases reliably, it is concluded that the infant hears the stimulus. This same response is often used to evaluate the infant's capacity for discrimination. One vocal stimulus is repeatedly presented to the subject until the response rate decreases by about 20%, then a new vocal stimulus is presented. If response rate increases reliably, it can be asseumed that the infant discriminates between the two stimuli.

These procedures (that are based on presenting auditory stimuli contingent on responses) have the advantage of being acceptable to persons with very limited skills and development. This is especially true with the high-amplitude sucking response. Since the sucking response is present soon after birth, it allows for evaluation with very young infants. There really is no problem when response rate differences are demonstrated between baseline and contingent auditory stimulation. Such differences indicate that the infant hears the stimulus. However, when there is no difference between baseline and contingent auditory stimulation, it may not be because of a failure to hear, but only due to lack of reinforcing properties of the auditory stimulus.

The high-amplitude sucking response has been used widely in group studies of the auditory perception of infants; however, research showing reliable intra-subject differences is very limited. For this reason, the use of contingent auditory stimuli as a procedure for evaluating the auditory processes of infants suspected of being deaf-blind will probably remain limited.

Implications for the Target Population

Behavioral audiometry has primary implications for educational management or teaching. While immittance audiometry and evolked potential audiometry provide important information concerning the intactness of the auditory system, they cannot provide the definitive information concerning functional hearing that can be provided with behavioral audiometry. The procedures that comprise behavioral audiometry can determine whether a specific tone or speech signal can serve as either discriminative stimulus or as a reinforcer for behavior. These two functions are major components of an educational training program. Further, for many children, the procedures for teaching the skills necessary for obtaining information about hearing are essentially the same as the procedures used in teaching auditory comprehension or instruction following. Thus, in addition to obtaining valuable information concerning hearing, behavioral audiometric techniques may also provide more general information relevant to a child's educational management.

Summary

In this report techniques for evaluating the hearing of infants and other difficult-to-test subjects have been reviewed. There were no attempts in the report to review the causes of hearing deficiency, the specific relation of hearing deficiency and the development of speech or language, or the saliency of different types of auditory signals used as stimuli. The reader who wishes more than this cursory report provides will find the following publications very informative:

Fulton, R.T ., & Lloyd, L. L. (1975). Auditory assessment of the difficult-to-test. Baltimore: Williams & Wilkins.

Gerber, S. E., & Mencher, G. T. (1983). The development of auditory behavior. New York: Grune & Stratton, Inc.

Jerger, J. (Ed.). (1984). Pediatric audiology. San Diego: College Hill Press, Inc.

Shah, C. P., & Clay, W. A. (1983). Assessment of auditory function. In P. Brachen & K. Paget (Eds.), The Psychoeducational Assessment of Preschool Children. New York: Grune & Stratton.

References

Abahazi, D. A., & Greenberg, H. J. (1977). Clinical acoustic reflex threshold measurements in infants. Journal of Speech and Hearing Disorders, 42, 514-519.

Bench, J., Collyer, Y., Mentz, L., & Wilson, I. (1976a). Studies in infant behavioral audiometry: I. Neonates. Audiology, 15, 85-105.

Bench, J., Collyer, Y., Mentz, L., & Wilson, I. (1976b). Studies in infant audiometry: I. Six-week-old infants. Audiology, 15, 302-314.

Bluestem, C., Berry, Q., & Paradise, J. (1973). Audiometry and tympanometry in relation to middle ear effusion in children. Laryngoscope, 83, 594-604.

Clifton, R., Morrongiello, B. A., Kulig, J. W., & Dowd, J. M. (1981). Developmental stages in auditory localization in infancy. In R. Aslin, J. Alberts & M. Peterson (Eds.), The development of perception: Audition, somatic perception, and the clinical senses (Vol. 1). New York: Academic Press.

Eimas, P. D., Siqueland, E. R., Jusczyk, P., & Vigorito, J. (1971). Speech perception in infants. Science, 171, 303-306.

Friedlander, B. Z. (1968). The effects of speaker identity, voice inflection, vocabulary and message redundency on infant selection of vocal reinforcement. Journal of Child Psychology, 6, 443-459.

Fulton, R. T., & Spradlin, J. E. (1972). SISI procedures with the severely retarded. Journal of Speech and Hearing Research, 15, 217-224.

Fulton, R. T., & Waryas, P. A. (1974). Studies in the detection of frequency differentials. In R. T. Fulton (Ed.), Auditory stimulus-response control. Baltimore: University Park Press.

Frisina, D. R. (1962). Audiometric evaluation and its relation to habilitation and rehabilitation of the deaf. American Annals of the Deaf, 107, 478-481.

Gerber, S. E., Gong, E. L., & Mendel, M. I. (1984). Developmental norms for the acoustic reflex. Audiology, 23, 1-8.

Goetz, L., Gee, K., & Sailor, W. (1983). Crossmodal transfer of stimulus control: Preparing students with severe multiple disabilities for audiological assessment. Journal of the Association for Persons with Severe Handicaps, 8, 3-13.

Hecox, K., Gerber, S. E., & Mendel, M. I. (1983). Development of auditory brainstem responses. In S. E. Gerber & G. T. Mencher (Eds.), The development of auditory behavior. New York: Grune & Stratton.

Jerger, J. (1980). Dissenting report: Mass impedance audiometry. Annals of Otology, Rhinology and Laryngology, (Suppl. 69), 21-22.

Jerger, J., Hayes, D., & Anthony, L. (1978). Effects of age on prediction of sensorineural hearing level from the acoustic reflex. Monographs in Contemporary Audiology, 1.

Jerger, J., Hayes, D., & Jordan, C. (1980). Clinical experience with auditory brainstem response audiometry in pediatric assessments. Ear and Hearing, 1, 19-25.

Ling, D., Ling, A. H., & Doehring, D. G. (1970). Stimulus response and observer variables in the auditory screening of newborn infants. Journal of Speech and Hearing Research, 13, 9-18.

Lloyd, L., Spradlin, J. E., & Reid, M. J. (1968). An operant audiometric procedure for difficult-to-test patients. Journal of Speech and Hearing Disorders. 33, 236-245.

Mendel, M. I. (1983). Development of the primary cortical auditory responses. In S. E. Gerber & G. T. Mencher (Eds.), The Development of Auditory Behavior. New York: Grune & Stratton.

Mendel, M. I., & Goldstein, R. (1971). Early components of the averaged electroencephalic response to constant level clicks during all-night sleep. Journal of Speech and Hearing Research, 14, 829-840.

Morse, P. A. (1974). Infant perception: A preliminary model and review of the literature. In R. L. Schiefelbusch & L. L. Lloyd, (Eds.), Language perspectives: Acquisition, retardation, and intervention (pp. 19-54). Baltimore: University Park Press.

Northern, J. L., & Downs, M. P. (1978). Hearing in children. Baltimore: Williams & Wilkins.

Orchik, D. J., & MacKimmie, K. S. (1984). Immittance audiometry. In J. Jerger (Ed.), Pediatric audiometry (pp. 45-70). San Diego: College Hill Press.

Robier, A., Lemaire, M. C., Garreau, B., Ployet, M. J., Martineau, J., Delvert, J. C., & Renaud, J. (1983). Auditory brainstem responses and cortical auditory-evoked potentials in difficult-to-test children. Audiology, 22, 219-228.

Salamy, A., & McKean, C. M. (1976). Postnatal development of human brainstem potentials during the first year of life. Electroencephalography and Clinical Neurophysiology, 40, 418-426.

Wilson, W., & Thompson, G. (1984). Behavioral audiometry. In J. Jerger (Ed.), Pediatric audiology (pp. 1-44). San Diego: College Hill Press.

Worthington, D. W., & Peters, J. F. (1984). Electrophysiologic audiometry. In J. Jerger (Ed.), Pediatric audiometry (pp. 95-124). San Diego: College Hill Press.

SFF84

V. Early Development of Prelinguistic Communication

Ellin Siegel-Causey and Doug Guess

In recent years instructional approaches have been developed that have provided professionals with procedures for teaching numerous skills to persons with severe handicaps. Communication skills training with this population, however, continues to be an area of great challenge to researchers and educators (Deich & Hodges, 1982; Gould, 1976; Hammer, 1982; Jones, 1980; Schiefelbusch, 1978; Sternberg, Battle, & Hill, 1980; Sternberg, Pegnatore, & Hill, 1983). Programs that promote communication for these persons emphasize the importance of having the child develop an adequate foundation for future language progression (Bates, 1976; Fieber, 1975, 1977; Robinson & Allen, 1975; van Dijk, 1965a, 1965b). This foundation begins at the prelinguistic level when young children learn to communicate with their body, eyes, gestures, etc., before acquiring a formal language system such as speech or sign language. Studies in the prelinguistic development of children with handicapping conditions (Hammer, 1982; Nixon, 1977; Sternberg, Battle, & Hill, 1980; Sternberg, Pegnatore, & Hill, 1983; Tweedie, 1982) offer brief descriptions of children's response repertoires in prelinguistic communication programs. From these studies it can be recognized that persons who are nonverbal need ways to express their likes and dislikes, to make choices and requests, and to indicate protest. The usual way in which such communication occurs is through the child's existing movements and behaviors. Unfortunately, despite the importance of these behaviors to immediate communication and in future language development, there are few measurement or training procedures for integrating the movement repertoires of prelinguistic students into intervention programs.

Thus, it is apparent that there is a considerable need to develop assessment tools to identify the child's prelinguistic repertoire and to develop intervention procedures that will integrate the existing skills of each child into communication enhancement programs. Consequently, research is underway at the University of Kansas to address these issues. The intent of this review is to provide an overview of the literature that is the foundation of this investigation. More specifically, the purpose of the manuscript is to provide a broad overview of prelinguistic interactions between children and their caretakers, and to identify variables that might affect the development of communicative competence in children who are deaf-blind. Areas to be discussed include communication patterns of children with severe handicaps and communication development in children with no apparent handicaps. The review begins with the theoretical constructs and philosophy that are the basis for our intervention strategies.

Theoretical Concepts

The impaired communication system of children with severe handicaps creates sensory isolation and can prevent the child from learning about the world through normal exploration patterns. Moreover, these children do not follow a normal progression of language acquisition that is enhanced through the integration of sensory modalities and expanding motor control. Often, persons with severe handicaps seem to live in a world of their own, focused on inward sensations with limited opportunity to learn from the environment through exploration or to learn through interactions with others.

The limited explorative and communicative behavior of deaf-blind children was observed by Jan van Dijk and led to the conceptualization of a theory that promotes the development of communication through movement (van Dijk, 1965a; 1965b, 1966, 1967, 1968, 1969). Van Dijk recognized that motor activity was one of the early and primary avenues through which infants and children learn about their own bodies and their world. Utilization of this movement-based theory requires the educator or caregiver to ". . . approach the total child in his existence. The child's world often goes no farther than his own body. The goal of education is to enlarge this world" (van Dijk, 1965a, p. 113). In the van Dijk approach communication enhancement is provided through a progression of stages that begins with awareness of self (Level 1); responding to motor sequences (Level 2); development of body scheme and coactive movements (Level 3); and development of symbolic gestures (Level 4). These four levels represent the presymbolic stages of the van Dijk theory and are presented in Figure 1.

Place Figure 1 About Here

Briefly, Level 1 is based on guiding the child to direct communication outward toward persons involved in their lives. At this level primary relationships involving warm social bonds evolve in the dyad when the caregiver interacts with the child in an accepting and warm manner. At Level 2, the promotion of movement and sensory experiences is emphasized with the child participating in movement activities with nurturing adults (caretakers, parents, teachers, etc.). During Level 3, activities progress from providing direct physical contact and sensory experiences between child and adult to co-active movements that involve some physical separation of the dyad Co-active or paired movements provide the child with simultaneous cues for the expected behaviors. For example, the child learns to follow the adult's movements with decreasing physical assistance or cues (the adult and student crawl to the lunch area side by side). Finally, in Level 4, natural gestures are encouraged during the ongoing movement activities. Natural gestures are those that correspond to the actions of an activity. Thus, "the child begins to express himself by using his body to represent objects or situations, the motor representation of the object, showing what you can do with it" (van Dijk, 1968, p. 6).

Within this communication framework, it is theorized that the child who is severely handicapped, or deaf/blind, will proceed from a presymbolic level of communication to a symbolic level. It should be noted, though, that the stages of communication progression beyond the level of natural gestures are not included within the scope of this review, but that van Dijk's writings do provide further information about the promotion of symbolic language.

The van Dijk approach provides a flexible theoretical framework with a model of progression that is overlapping. The procedures that have evolved from this theory center on entering the child's world by establishing a primary relationship; and by utilizing the child's own repertoire to form movement, sequences, or dialogues. These movement dialogues progress as the child learns separation of self, social awareness in the environment, the expression of signals, and the use of gestures. Van Dijk's work is available primarily from transcriptions of lectures given in the Netherlands or the United States (van Dijk, 1965a; 1965b; 1966; 1967; 1968; 1969; 1978), but several professionals have developed personal application of the approach into training materials. Two such models have been adapted into curricula: Prelanguage Curriculum Guide for the Multihandicapped (Curtis, Duning, Meese, Westover, Yost & Perroti, 1978) and the Custer Basic Development Curriculum of Cognitive and Language Training for Severely/Multiply Handicapped Adults and Children (Lantaff, Olson, LaPointe-Berringer, & Eckholm, 1982).

Figure 1

Levels of the van Dijk Progression of Communication Facilitation

Level 1: Ego consciousness
- learning the "me" and "not me"
- developing a nurturing relationship between child and teacher (or caregiver)
- toleration of body contact and paired movements

Level 2: Motor patterns

Resonance substage:
- experiencing things of action
- participating in movement with adults
- developing anticipation through movement sequences and through the start/stop of movement sequences

Level 3: Development of body schema
- experiencing the body as a unit
- developing image of body shape and body parts
- utilizing specific control of body parts

Co-active substage:
- displaying parallel movement sequences with physical contact
- displaying parallel movement sequences without physical contact

Imitation substage:
- displaying simultaneous imitation with symmetric and asymmetric limb movements
- displaying non-representational reference

Level 4: Natural gesture
- developing symbol awareness through movement sequences (decontextualization)
- transforming of natural signals or gestures into standard of full gestures

Note: adapted from Curtis, Dunning, Meese, Westover, Yost & Perroti, 1978; Hammer, 1982; and van Dijk, 1967.

Communication Patterns of Children with Severe Handicaps

The development of prelinguistic skills is rooted in the interactions and relationships that exist between the infant and the primary caregivers. Mothers and caregivers are sensitive to the varied nonvocal behaviors (e.g., gestural, visual, facial expression, movements, etc.) of their infants and to the unique patterns of interaction that are based on these behaviors. This reciprocal relationship develops and changes as caregiver and infant exchange information. "It has been our experience that patterns of communication manifest themselves in prelinguistic stages; the compatibility between the child and his parent with respect to communication and its topics can be fostered; the natural reciprocity of parent and child behavior provides each member of the dyad with frequent opportunities to feel effective . . . " (Simmons-Martin, 1981, p. 255). But, what if such reciprocity is not experienced by the infant or caretaker? A lack of attention and recognition of the limited signals the child with severe handicaps possess can contribute to the child's passivity and withdrawal. This type of reaction can be termed "iatrogenic retardation" (Kearsley, 1979) and "learned helplessness" (Seligman, 1975).

Kearsley (1979) describes iatrogenic retardation as a syndrome of learned incompetence that results from the manner in which an individual is treated. More precisely, it is a " . . . lowered level of expectation that may result in the child's failure to achieve neuromotor landmarks" (1979, p. 171). During early infant interactions, "the consistency, timing, and quality of the caregivers responses create expectancies about control and competence" (Lewis and Brooks-Gunn, 1979, p. 7). Thus, in communication programs for persons with severe handicaps it is imperative to attend to such interactive qualities. In line with this concept, Kearsley emphasizes the need to provide a developmental diagnosis for the child with alternative assessment procedures that predicts cognitive development and delineates the infant's communication repertoire. A failure to do so can promote the child's incompetence through a lack of expectation from attending adults. However, by accurately assessing what the child does communicate, expectations for further development can be created.

Seligman (1975) addresses the "secondary" impact of the handicapping condition(s) in a slightly different fashion. Specifically, Seligman presents the concept of learned helplessness as a result of a dual interaction between the child and the environment that reinforces helpless and dependent behaviors on the part of the child. To illustrate, handicapping conditions can often lead to a deficiency in the child's ability to impact or control the environment. Consequently, the child can become passive and stop attempting to control events and/or persons in the environment. This concept of learned helplessness can be extended to the nonvocal child with severe handicaps who cannot exhibit a wide range of behavior, and who is unable to signal communicative intent to the caregiver. In addition, the caregiver of that child might not expect the child to communicate and, therefore, may fail to respond to nonvocal signals. Both of these impaired channels of interaction would contribute to the dependency and passivity (i.e. learned helplessness) of the child.

It is clear that the communication system between caregivers and children with severe handicaps can impact upon the joint relationship of the dyad and impair the development of language skills in the child. A developmental approach can be utilized to guide interventions in these relationships. A model based on the communication development of children with no apparent handicaps that has potential for application with children who are deaf-blind or severely handicapped is provided in the next section.

Communicative Development

Children with deaf-blindness present a great challenge to professionals who seek to provide these children with a suitable foundation for early communication development. The focus of the intervention strategies at the University of Kansas is on providing caretakers and educators with communication enhancement activities that: a) incorporate the salient variables identified in the literature on normal infant communication development, and b) relate to the theoretical and programmatic assumptions of van Dijk's movement-based approach to intervention. In order to be effective both objectives must be grounded in knowledge gleaned from research on normal language development. In this section then, a review of sensory aspects of early communication, nonvocal communication, communicative interactions and interactional processes will be offered.

Early Communication and Sensory Feedback

In the past the infant was viewed as an undifferentiating organism who responded globally to stimuli. In recent years, though, research has been conducted that documents the sensitivity of infants to respond discriminately to visual, auditory, tactile, and related sensory output. The newborn demonstrates the capacity to perceive, respond, learn, and adapt to the early social environment. Trevartehn (1977, p. 227) refers to the infant as " . . . highly competent-as endowed with complex functional abilities . . . and is now seen as a sensitive and impressionable perceiver." Stated otherwise, the infant actively participates in the environment using sensory, social, and cognitive skills to process and organize diverse types of stimuli. Further, it is known that in the first few months of life the infant discriminates between animate and inanimate social environments (Richards, 1974), differentially responds to familiar social stimuli (Sherrod, Crawley, Petersen, & Bennett, 1978), and habituates to redundant stimuli (Kagan, Kearsley, & Zelazo, 1978). The refinements of both sensory and sensory-motor feedback occurs from birth on. These discriminations develop within the dependent relationship the infant has with the primary caregiver and through interactions with the environment.

Pylyshyn (1977, p. 38) offers three preconditions for the development of language:

> 1. Sensory experience must be structured . . . some aspects must be foregrounded relative to others so that the environment becomes articulated or differentally noticed in some fashion;
> 2. Communication codes (both verbal and non-verbal) must likewise be structured . . .;
> 3. The occurrence of a speech act must be recognized . . . recognition that an event is a speech act with meaning potential . . .

In short, Pylyshyn points out the importance of the discrimination and structuring of sensory stimuli in prelinguistic development. Moreover, refinements of the environment must include the fact that vocal or gestural behaviors are segmented and that the infant must discriminate and attend to these aspects of behavior to acquire meaningful prelinguistic skills.

Thus, it may be concluded that communicative behavior between an infant and an adult should involve a highly controlled, cooperative, and spontaneous use of expression. Such communication transmits to both members of the dyad subjective information concerning feelings, intentions, and awareness (Trevarthen, 1977). Clearly, descriptions of interactions between infants and caregivers can provide important information about the salient variables in nonverbal communication exchanges.

Caretaker Sensitivity to Nonvocal Behaviors

Thoman (1981, p. 192) provides a basis for characterizing mother-infant interactions as affective and ongoing communication: "a. Each partner exhibits a range of expressive, affective behaviors; and b. These behaviors constitute a feedback system that produces a 'coupling' of mother and infant behaviors." It has also been documented that interactions between caretakers and infants include initiation and maintenance of communicative behavior, and that infants have the capacity to terminate and avoid interaction (Stern, 1977; Trevarthen, 1977). These early interactions are based on eye and body movements, facial expression, gestures, and vocal sounds. In this area particular attention has been paid to visual responses and gestures (Bates et al., 1982; Fraiberg, 1974; Masur, 1981; Moerk, 1977; Robson, 1968).

Responsiveness to visual behavior. Visual behavior, particularly eye contact, assumes an important role in communicative exchanges between infants and adults. Adults interpret particular visual responses as indicators of infant discriminations, recognition, and preferences. The affective nature and potency of eye contact was reported initially by Ronson (1968); and visual responses and the associated facial expressions were further described by Fraiberg (1974). She identified the following visual signs that are equated with communicative characteristics:

1. Looks attentive (sustained visual regard)
2. Looks of longing (prolonged visual attention)
3. Looks puzzled (visual inspection of unfamiliar)
4. Looks doubtful (visual inspection with positive and negative emotion)
5. Coy look (visual peekaboo game)
6. Is bored (unfocused searching or scanning)

Early communicative behavior includes both visual discrimination skills of infants and the affective interpretation by adults of what the visual signals represent.

Responsiveness to gestural behaviors. Gestural behavior also influences early communicative exchanges. Infant gestures have been shown to influence the behavior of mothers (Masur, 1981) and it has been suggested that minimal gestural communication might preceed speech (Bates et al., 1982; Moerk, 1977). At least part of the foundation of the infant's communicative process is based on the integration of gestures and vocalization by both the infant and the caregiver.

The communicative exchanges of mothers and infants, with particular attention to the gestural aspects of the interactions, were studied by Hubley and Trevarthen (1979, p. 74-75). These gestures illustrate the nonverbal aspects of communication within the dyad and can be catagorized as follows:

1. Acts of joint praxis:
    a) by either mother or baby: points, shows, gives, offers, takes object, follows manipulation, imitation, regulates object, resists, touches with another object;
    b) by baby only: reaches, acquiesces, accepts assistance, complies;
    c) by mother only: shows interest, manipulates to follow interest, assists, asks, indicates a locus, moves toys nearer, indicates an object, indicates a further object, demonstrates, imposes an act.

2. Interpersonal acts: smiles, laughs, looks at person's face, leaning toward baby, reaches toward mother, touching the partner, vocal imitation.

The importance of reciprocal social-communicative exchanges on the development of receptive language in the child is emphasized further by Bricker and Schiefelbusch (1984). The infant assigns meaning to auditory, gestural, and visual signals that provide social and physical feedback about the environment. Carlson and Bricker (1982) discuss the importance of the infant's orientation to relevant visual, auditory, and tactile stimulation in the environment. Once these orientation responses are acquired, the infant learns to sustain interest in objects, persons, or situations and develops additional attention skills. This allows the infant to gather information beyond initial discriminations and interactions.

The receptive components and discriminatory capabilities in the infant provides a range of responses that are extended to include orientation, recognition, and expression. The effect of the sensory stimulation and discrimination combines with the physical and social environment of the child. These integrated components provide the basis for receptive language development. The next section addresses aspects of caregiver/infant interactions that influence early prelinguistic development.

Early Communicative Interactions

Unique and personal communicative interactions between the caregiver and infant develop easily into reciprocal exchanges through daily routines (e.g., diapering, feeding, exchanges with toys or objects, play incorporating object appearance and disappearance, peekaboo, tickling, etc.) Embedded within these interactions are three salient behaviors: turn-taking, babytalk (motherese), and gestures.

Interactive routines. When interacting with a caretaker the infant uses short cycles of looking and looking away, shows many mouth and facial movements, and displays a variety of body movements. These cycles show gradual build-up and disengagement and vary in tempo and rhythm. These behaviors are distinctive of interpersonal interactions (Brazelton, Koslowski, & Main, 1974; Stern, 1977; Trevarthen, 1977).

Interactions within the dyad usually begin with greetings and the establishment of eye contact. The mother's body and facial movements, and rhythmic speech, allows responses to be elicited from the infant. The mother may also imitate the facial expressions of the infant, providing even more of a shared experience. Conversely, the child's changes in facial expression, vocalizations, and motor patterns are integrated into a personal rhythm. Fafouti-Milenkovic and Uzgiris (1979) indicate that these behaviors combine to suggest conversation.

The earliest mother-infant games develop joint rhythm more than strict turn-taking. Stern and his collegues (1977) describe early mother-infant interactions as a dance, later developing to turn-taking games of repetitive forms -- "first you do this, then I do that". These turn-taking sequences emerge as the infant progesses from being a spectator, to responding to behavioral rhythms, and later to imitating the actions of the mother (Bretherton & Bates, 1979). As the development of intentionality and reciprocity increases, interactive routines are developed. Such routines are established in daily sequences of play such as peekaboo (Bruner & Sherwood, 1976; Greenfield, 1972) and give-and-take (Bruner, 1977; Gray, 1978). The mother will exaggerate, slow down, and repeat both her verbal and nonverbal behavior in order to maintain or heighten the infant's interest and attention. Mothers often spend time watching cues from their infants in order to gauge the timing and appropriateness of their interactions.

All of these items relate to the van Dijk sequences from Level 1 (refer to Figure 1). The movement sequences are based on the child's spontaneous motor patterns that are incorporated into repeated dialogues of movement. This integration of motor patterns requires sensitivity of the educator or caretaker to the child's responses to routines, games, and ongoing interactions. Van Dijk asserts that a nurturing primary relationship should be developed through the movement sequences that occur during daily routines. Consequently, utilization of the van Dijk techniques allows the educator and child to develop their own unique interactions and communicative patterns in much the same way as mothers and infants develop their own interaction rhythms and routines.

Child-oriented speech. In addition to the development of unique interactions between mother and infant, a special form of speech is also developed. This type of speech is called baby talk or "motherese." It has been established that adults speak to infants and young children in ways that are markedly different from the ways they interact with adults. Examples of such speech patterns include: special vocal register (Ferguson, 1977); higher pitch, special intonations, and rhythmic patterns (Sachs, 1977); short and simple sentences, prolongation of certain words, and rising pitch at final sentences (Garnica, 1977); and self repetitions by the mother (Cross, 1977). The caretaker or adult may employ these various features to control attention, improve intelligibility, and specify utterances directed toward the child (Brown, 1977; Cromer, 1981).

Chapman (1981) provides a detailed analysis characterizing the speech of mothers. Mothers tend to utilize phonological, syntactic, semantic, and pragmatic changes when speaking to infants and young children. Further, mothers employ characteristics of speech that include: a) Prosodic changes; higher frequency, greater frequency range, occasional whispering, longer duration of context words, more than one stress, slower rate, pauses at utterance boundaries, high intelligibility; b) Syntactic changes; shorter utterance length, predominant questions, well-formed sentences syntactically; and c) Semantics changes; lower diversity of words, higher frequency of same vocabulary, concrete words.

It can be reasoned that to make messages clear and personal for infants, intervention programs should employ speech patterns similar to those used in the dyad. Inclusion of the various prosodic, semantic, and syntactic elements reviewed may aid the communicative interaction. It is possible for sign language to be paired with verbal input and varied to maintain and heighten the child's interest and attention.
Further, verbal and sign language input should relate to natural events and objects as they occur in the child's environment. In this way, the intervention will follow the normal development of communication.

Gestures. An infant's comprehension of gestures, particularly the pointing gesture, is important to indicate interest and to lead interactions (Murphy & Messer, 1977). Many studies on mothers' responses to infant gestures have been directed towards interactions that occur when infants and caretakers view pictures in books. Masur (1981) examined mothers' responses to children's gestures of pointing, extending objects, and open handed reaching. It was found that mothers respond differently to the child's pointing gestures, reciprocating to a greater degree with labels of the indicated objects. The child, in turn, produces more object-labelling words with pointing than with other gestures. Obviously, pointing is a salient feature in early linguistic development, but it should be noted that more general gestures also have important components that occur throughout daily routines and play. These include: extending a real-life object; using an object similarly to a real-life object (drinking from the can that holds toys); pulling an adult's hand toward a wind-up music toy that just stopped playing; and bringing a toy up and down coupled with exaggerated vocalizing of "aa" (up), and "uh" (down).

Adults also use gestures when interacting with infants and children. Macnamara (1977) asserts that the infant must discern the speaker's intention through such gestures to distinguish which object is being discussed, commands versus statements, and other features of communication that are understood through syntax. The infant uses nonlinguistic aspects of objects, events, and signals as clues to intention. These clues can include movements of objects, gestures, and eye contact. In Macnamara's extensive research it was found that if the infant understands verbal instruction s/he responds to it and depends on it, however, the infant can be misled by a look or gesture. In general, it appears that a gesture is more powerful than unknown words used by caregivers in interacting with infants.

Interactional Communicative Processes

The interactions between infants and adults are an integral function of the early language development in the child. Important aspects of these social interactions include the initiation and maintenance of the infant's attention, the cycles of responses in the dyad, and the caregiver's responsiveness.

Initiation and maintenance of infant communication. "Establishing the 'process of communication' is largely the task of the mother or other caregiver and requires that she be attentive to the potentially communicative gestures and vocalizations the infant produces, synchronizing her own activity . . ." (Wells, 1981, p. 96). Stern (1977) points out some specific, essentially nonverbal, behaviors are incorporated into early mother-infant interactions and provide a framework for nonverbal and/or verbal communication. In order to maintain infant attention and interaction, mothers tend to exaggerate behavior by varying the timing and rhythm of their movements, vocalizations, and facial expressions. Such interactions between caregivers and infants contain bursts of activity (tune-in) interspersed with periods of relative quiet (tune-out). The infant needs to be aware of sensory and social stimuli that indicate a communicative exchange might occur. These signals of readiness vary across infants, but often include: head orientation, body orientation, eye gaze, and distance reduction. These behaviors may occur singularly or in combination and provide overt evidence to the adult that the infant is ready to communicate (Bricker & Schiefelbusch, 1984).

Interaction cycles. During the last half of the first year of life, the infant participates actively in social interaction. The structured cycles of responses described by Bricker and Schiefelbusch (1984) and Brazelton et al. (1974) consist of:

1. Initiation: Infant vocalizes while looking at adult to attract attention
2. Mutual Orientation: Infant vocalizes and adult focuses on face
3. Recognition: Infant smiles when seeing adult, establishing joint reference
4. Reciprocal Play-Dialogue: Adult vocalizes and infants vocalizes.
5. Disengagement: Adult vocalizes and infant looks away.

Brazelton et al. (1974) also discuss the nuances of specific behavior(s) that gain responses from the infant. Qualities that may change the meaning of a behavior include force (touch), tempo (synchrony of movements or vocalizations), and distance (amount of distance paired with vocalization, gesture, etc.). Within these differences are patterns of timing and contexts. The authors direct particular attention to the importance of the mother's sensitivity to the infant's attention/nonattention and responses during interactions.

Infants develop an effective communication system with their primary caregiver(s) long before they develop language. Carlson and Bricker (1982) suggest viewing the interactional process as a mutually regulated system in which each member of the dyad adapts and modifies their own behaviors. As the infant displays the capability to initiate and direct activities the caregiver reduces his/her dominance in the interactions. This synchrony of cycles requires sensitivity to all of the infant's motor and vocal signals. The infant must also signal clearly and predictably about needs and states when responding to the caregiver's communication.

Caregiver responsiveness. Many researchers claim that during the early developmental period the primary caregiver is a major influence on the quality and direction of growth. Caregivers display sensitivity to the nonverbal behavior of the infant by incorporating them into communicative exchanges and by building these behaviors into interactional patterns. During interactions the caregiver's behavior combines with the infant's behavior and forms a unique pattern of communication. These individual patterns impact upon the infant's receptive skills; i.e., those capabilities that are necessary to attend, organize, and act upon the environment. In addition, the content, sequence, and timing of the interaction patterns facilitate the development of linguistic communication (Zukow, Reilly, & Greenfield, 1982).

Basic routines of daily care (e.g., eating, dressing, diapering, etc.) are rooted in the social life of infancy, with language stimulation permeating these daily activities. Caretakers employ language interactions in basic care routines, social play, looking at objects and pictures, and general labeling throughout the environment. The timing, or synchrony, of the caretakers' response to the infant seems to have the potential for affecting the quality of their relationship (Oscofsky, 1976). Synchrony can be described (Bricker & Carlson, 1981, p. 493) as the " . . . parents' ability to monitor, state, mood, or needs of the child and respond in a facilitating manner according to the childs need."

It is important for the professional to recognize what parents do naturally to foster communication development with their infant(s). Simmons-Martin (1981, p. 255), in providing information on promoting language development in children who are deaf, notes four characteristics of parental behavior that facilitates communication:

1. Establishing compatibility with the dyad--dyadic compatibility;
2. Utilizing non-verbal clues for initiation and follow through in communication--patterns of communication;
3. Seizing opportunities for inspiration of affection--affective dyadic feedback; and
4. Demonstration of competence relative to general behavior as well as linguistic--behavior competence.

Schaffer (1977) emphasizes the importance of reciprocity and intentionality in language development. Reciprocity refers to the role the infant plays in the interaction sequences. In order for communication to occur, the infant and caregiver must assume roles of both initiator and responder. Each member of the dyad influences the other's behavior in a reciprocal manner. The balance of reciprocity changes as the infant participates to a greater extent in the dyad. Also, as the infant matures s/he displays more dominance in initiating activities. Many researchers point to the caretaker's interpretation of the infant's responses as having communicative significance (Neweson, 1977; Stern, 1977). Intentionality begins to develop once the infant recognizes that his/her behavior has communicative value and can effect the behavior of others (Bates et al., 1982; Treverthen, 1977).

Interpretation of nonvocal behaviors. The infant's nonvocal behaviors (eye contact, body movements, gestures, etc.) are accepted by the caregiver as expressions of communication. Nonvocal competencies form an integral part of prelinguisitc development that facilitates progress in language acquisition.

When interacting with infants, caregivers ". . . make the assumption that the infant is attempting some form of meaningful dialogue, and out of this assumption the communication of shared meanings begins to take place" (Newson, 1977, p. 208). The infant's behavior consists of brief episodes of head, eyes, eyebrows, hands, arms, legs, etc. that form social interaction and communication. From birth caregivers interpret infant behavior as containing wishes, intentions, and feelings. Through constant monitoring the caregiver interprets meanings prior to the time the infant recognizes their significance.

In normal infant interaction, ". . . over and over again, events which are at first the results of automatic action patterns, or which are quite accidental and beyond the control of either mother or child, are endowed with signifigance because of either the way the mother reacts towards the child in light of the event and its effect upon him" (Newson, 1979, p. 212). Hopkins (1983) discusses the role of maternal interpretation of infant behavior in early nonverbal communication. His orientation is "intuitive" in nature and is based on mother and infant building communication through a shared code that is coupled with subjective experiences.

Thus, under normal conditions the behavior of infants and their caregivers is adapted for reciprocal interactions. However, if the child displays limited visual behaviors or limited body movements, it is more difficult for a reciprocal exchange to progress with the caretaker. Nelson (1973) found that too passive a baby causes interactions in the dyad to decrease, a condition which ultimately hampers language growth. The child with severe handicaps has impairments that may limit body movements, facial expression, visual and auditory behavior, etc. Such limitations of expression can influence the reciprocal relationship and communicative development that occurs between caregiver and infant.

The child with severe handicaps may need particular attention, structure, or prolongation of this prelinguistic stage of learning to gain meaning from motor, vocal or expressive behaviors. Newson (1979) states that, ". . . it is a matter of supreme importance that meaning is inputed in some reliable and consistent way, because without this the human dialogue could never begin" (p. 212). Such consistency is even more important to children with severe handicaps due to the limitations of their communication faculties.

Those persons interacting with children who have severe handicaps must be sensitive to the signals expressed and received by the child. Orienting movements and gaze are the first means that can be used to detect what infants are attending to and to begin communication behaviors. These same basic movements and orienting patterns may be one of the few means the child with severe handicaps has for signaling needs, desires, preferences, etc. "In order for anyone to participate in communication with another, it is necessary for him to have some way to signal and some way to receive and interpret messages." (Bullowa, 1979, p. 23).

Lewis and Goldberg (1969) recognized that a child's behavior is related to predictable communication outcomes. They formulated a "generalized expectancy model" that emphasizes contingent mother-infant interactions. This type of interaction helps to develop the infant's concept of affecting the environment and the way the impact of his/her actions are viewed. The social-communicative exchanges of infant and caregiver are connected together in the natural environment and are mutually contingent on one another. As the infant matures, ". . . contingency games in which the behavior of the partners is mutually rewarding are played with increased frequency" (Carlson and Bricker, 1982, p. 301). Consequently, the contingent feedback provided by the caregiver to the infant's signals appears to be instrumental in fostering the development of communication.

Implications for Children with Deaf-Blindness

Caregivers arrange the environment and their interactions with the infant to enhance learning and development. Infants and caregivers engage in rhythms of gazing, reaching, postural adjustments, facial expressions, hand gestures, touching, etc., that build individual patterns of interaction, cycles of responsiveness. These interactions form the basis for early communication development. It is important for the professional to understand the fragility of this necessary prelinguistic foundation when considering the many variables that impact upon the communication development of the child with severe handicaps. To be effective intervention strategies for communication enhancement must incorporate the current knowledge of normal language progression in infancy.

The purpose of the research being conducted at the University of Kansas is to investigate the relationship of some of the salient variables of normal prelinguistic development with children who are deaf-blind. These children are between 1 to 5 years of age and are functioning at a developmental level of 0 to 12 months. The van Dijk approach, utilizing the child's own behavioral repertoire to form movement dialogues as part of nurturing relationships, forms the basis for the intervention. The intervention that is employed, though, recognizes and incorporates the variables of infant prelinguistic development including structuring sensory input, responsiveness to nonverbal behaviors (visual, gestural, body movements), reciprocity in interventions, interactive routines, and cycles of responsiveness.

Further, because there are few instructional procedures or formats for utilizing the van Dijk model we intend to promote communication development in prelinguistic children with deaf-blindness by evaluating child-centered movement-based training. Our efforts are directed towards identifying those motor and vocal behaviors emitted by the child that can be expanded and developed into more formalized and functional communication systems. As part of this research coding procedures have been developed for assessing and identifying potential child communicative responses. In addition, coding procedures for observing caregiver responses to the child during natural interactions have been constructed. Results from this study will be incorporated into instructional procedures to train caregivers to expand communication repertoires of children through systematic cueing and movement dialogues. Hopefully, this project will lead to a greater understanding of van Dijk intervention techniques and have a positive impact on the communication development of children who are deaf-blind.

References

Bates, E. (1976). Language and context: The acquisition and pragmatics. New York: Academic Press.

Bates, E., Bretherton, I., Shore, C., & McNew, C. (1982). Names, gestures, and objects: The role of context in the emergence of symbols. In K. E. Nelson (Ed.), Children's Language--Volume 4 (pp. 59-124). New Jersey: Lawrence Erlbaum Associations.

Brazelton, T. B., Koslowski, B., & Main, M. (1974). The origins of reciprocity: The early mother-infant interaction. In M. L. Lewis & L. A. Rosenblum (Eds.). The effect of the infant on its caregiver (pp. 49-77). New York: John Wiley and Sons.

Bretherton, I., & Bates, E. (1979). The emergence of intentional communication. In I. C. Uzgiris (Ed.), Social interaction and communication during infancy (pp. 81-100). San Francisco: Jossey-bass, Inc.

Bricker, D., & Carlson, L. (1981). Issues in early language intervention. In Schiefelbusch & D. D. Bricker (Eds.), Early language: Acquisition and intervention (pp. 477-516). Baltimore: University Park Press.

Bricker, D., & Schiefelbusch, R. (1984). Infants at risk. In L. McCormick & R. Schiefelbusch (Eds.), Early Language Intervention (pp. 243-266). Columbus: Charles E. Merrill Publishing Co.

Brown, R. (1977). Introduction. C. E. Snow & C. A. Ferguston (Eds.), Talking to children: Language input and acquisition (pp. 1-17). Cambridge: Cambridge University Press.

Bruner, J. (1977). Early social interaction and language acquisition. In H. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press.

Bruner: J. S., & Sherwood, V. (1976). Peekaboo and the learning of rule structures. In J. S. Bruner, A. Jolly & K. Sylva (Eds.), Play: Its role in development and evolution. New York: Basic Books.

Bullowa, M. (Ed.) (1979). Before speech: The beginning of interpersonal communication. London: Cambridge University Press.

Carlson, L., & Bricker, D. (1982). Dyadic and contingent aspects of early communicative intervention. In D. Bricker (Ed.), Intervention with at risk and handicapped infants: From research to application (pp. 291-308). Baltimore: University Park Press.

Chapman, R. S. (1981). Mother-child interaction in the second year of life, its role in language development. In R. L. Schiefelbusch & D. D. Bricker (Eds.), Early langauge: Acquisition and intervention (pp. 291-308). Baltimore: University Park Press.

Chapman, R. S., & Miller, J. F. (1980). Analyzing language and communication in the child. In R. L. Schiefelbusch (Ed.), Nonspeech language and communication. Analysis and intervention. Baltimore: University Park Press.

Cromer, R. F. (1981). Reconceptualizing language acquisition and cognitive development. In R. L. Schiefelbusch & D. Bricker (Eds.), Early language: Acquisition and intervention. Baltimore: University Park Press.

Cross, T. G. (1977). Mothers' speech adjustments, the contributions of selected child listener variables. In C. E. Snow, & C. E. Ferguson (Eds.), Talking to children: Language input and acquisition. Cambridge: Cambridge University Press.

Curtis, C., Dunning, L.M., Meese, B., Westover, L., Yost, K. & Perotti, N. (1978). A prelanguage curriculum guide for the multihandicapped. Colorado Springs: Colorado School for the Deaf and Blind.

Fafouti-Milenkovic, M., & Uzgiris, I. C. (1979). The mother-infant communication system. In I. C. Uzgiris (Ed.), Social interaction and communication during infancy (pp. 41-56). San Francisco: Jossey-Bass, Inc.

Ferguson, C. A. (1977). Baby talk as a simplified register. In C. E. Snow & C. A. Ferguson (Eds.), Talking to children: Language input and acquisition. Cambridge: Cambridge University Press.

Fieber, N. (1977). Sensorimotor cognitive assessment and curriculum for the multihandicapped child. Nebraska: Media Resource Center, Meyer Children's Rehabilitation Institute.

Fieber, N. (1975). Movement in communication and language development of deaf-blind children. Nebraska: Media Resource Center, Meyer Children's Rehabilitation Institute.

Frailberg, S. (1974). Blind infants and their mothers: An examination of the sign system. In M. L. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver (pp. 215-232). New York: John Wiley and Sons.

Friedlander, B. Z. (1970). Receptive language development in infancy: Issues and problems. Merill Palmer Quarterly, 16, 7-51.

Garnica, O. K. (1977). Some prosodic and paralinguistic features of speech to young children. In C. E. Snow & C. A. Ferguson (Eds.), Talking to children: Langauge input and acquisition. Cambridge: Cambridge University Press.

Gould, J. (1976). Language development and non-verbal skills in severely mentally retarded children: An epidemiological study. Journal of Mental Deficiency Research, 20, 129-146.

Gray, H. (1978). Learning to take an object from the mother. In A. Lock (Ed.) Action, gesture, and symbol: The energence of language. London: Academic Press.

Greenfield, P. M. (1972). Playing with a four-month old: A study of the role of speech and non-speech sounds in the formulation of a visual schema. Journal of Psychology, 32, 287-298.

Hammer, E. (1982). The development of language in the deaf-blind multihandicpped child: Progression of instructional methods. In E. Shroyer & D. Tweedie (Eds.), The multihandicapped hearing impaired child (pp. 193-200). Washington, D.C.: Gallaudet College.

Hopkins, B. (1983). The development of early non-verbal communication: An evaluation of its meaning. Journal of Child Psychology and Psychiatry, 24, 131-144.

Jones, O.H.M. (1980). Prelinguistic communication skills in Down's syndrome and normal infants. In T. Field (Ed.), High-risk infants and children: High-risk infants and children: Adult and peer interactions (pp. 205-225). New York: Academic Press.

Kagan, J., Kearsley, R., & Zelazo, P. (1978). Infancy: Its place in human development. Cambridge: Harvard University Press.

Kearsley, R. B. & Siegel, I. E. (Eds). (1979). Infants at risk: Assessment of cognitive functioning. New Jersey: Lawrence Erlbaum Associates.

Lantaff, D., Olson, D., LaPointe-Beringer, L., & Eckholm, S. (1982). Custer Basic Development Curriculum. Custer, South Dakota: Custer State Hospital.

Lewis, M., & Brooks-Gunn, J. (1979). Toward a theory of social cognition: The development of self. In I. Uzgiris (Ed.), Social interaction and communication during infancy (pp. 1-9). San Francisco: Jossey-Bass Inc., Pub.

Lewis, M., & Goldberg, S. (1969). Perceptual-cognitive development in infancy: A generalized model as a function of the mother-infant interaction. Merrill Palmer Quarterly, 15, 81-100.

Lewis, M. L. & Rosenblum, L. A. (Eds.)(1974). The effect of the infant on its caregiver. New York: John Wiley and Sons.

Macnamara, J. (1977). From signs to language. In J. Macnamara (Ed.), Language learning and thought. New York: Academic Press.

Masur, E. F. (1981). Mothers' responses to infants' object-related gestures: Influences on lexical development. Journal of Child Language, 9, 23-30.

McCormick, L., & Schiefelbusch, R. L. (1984). Early Language Intervention. Columbus: Charles E. Merrill Publishing Co.

Moerk. E. L. (1977). Pragmatic and semantic aspects of early language development. Baltimore: University Park Press.

Murphy, C. M. & Messer, D. J. (1977). Mothers, infants, and pointing: A study of gesture. In H. R. Schaffer (Ed.), Studies in mother-infant interaction (pp. 47-61). London: Academic Press.

Nelson, K. (1973). Structure and strategy in learning to talk. Monographs of the society for research in child development, 38(149), 1, 2.

Newson, J. (1979). The growth of shared understandings between infant and caregiver. In M. Bullowa (Ed.), Before speech: The beginning of interpersonal communication. London: Cambridge University Press.

Newson, J. (1977). An intersubjective approach to the systematic description of mother-infant interaction. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press.

Nixon, R. (1977). Pre-language sensorimotor stimulation/integration program for the development of cognition and communication. Portland Public Schools, Providence Child Center.

Osofsky, J. (1976). Neonatal characteristics and mother-infant interaction in two observational situations. Child Development, 47, 1138-1147.

Pylshyn, Z. W. (1977). What does it take to bootstrap a language? In J. Macnamara (Ed.), Language learning and thought. New York: Academic Press.

Richards, M. (1974). The integration of a child into a social world. London: Cambridge University Press.

Robinson, P., & Allen, P. (1975). An educational approach utilizing developmental sequencing and the coactive movement theory. Indiana: Northern Regional Service Center.

Robson, K. (1968). The role of eye contact in maternal infant attachment. In S. Chess & A. Thomas (Eds.), Annual progress in child psychiatry and child development. New York: Brunner/Mazel.

Sachs, J. (1977). The adaptive significance of linguistic input to prelinguistic infants. In C. E. Snow & C. A. Ferbuson (Eds.), Talking to children: Langauge input and acquisition. Cambridge: Cambridge University Press.

Schaffer, H. R. (1977). Early interactive development. In H. R. Schaffer (Ed.), Studies in mother-infant interaction (pp. 3-16). London: Academic Press.

Schiefelbusch, R. L. (1978). Bases of language intervention. Baltimore: University Park Press.

Seligman, M. (1975). Helplessness: On depression, development, and death. San Francisco: W. H. Freeman.

Sherrod, K., Crawley, S., Peterson, G., & Bennett, P. (1978). Maternal language to prelinguistic infants: Semantic aspects. Infant Behavior and Development, 1, 335-345.

Simmons-Martin, A. (1981). Acquisition of language by under-five, including the paternal role. In A. M. Mulholland (Ed.), Oral education today and tommorrow (pp. 250-271). Washington, D.C.: Alexander Graham Bell Association for the Deaf.

Stern, D. (1980). Infant signals of readiness to communicate. In A. P. Reilly (Ed.), The communication game. Johnson and Johnson Baby Products Co.

Stern, D. (1977). The first relationship: Infant and mother. Cambridge, MA: Harvard University Park Press.

Sternberg, L., Battle, C., & Hill, J. (1980). Prelanguage communication programming for the severely and profoundly handicapped. Journal of Severely Handicapped, 5, 224-233.

Sternberg, L., Pegnatore, L., & Hill, C. (1983). Establishing interactive communication behaviors with profoundly and mentally handicapped students. Journal of Severely Handicapped, 8, 39-46.

Sugarman, S. (1978). Some organization aspects of pre-verbal communication. In I. Markova (Ed.), Social Context of Language (pp. 49-66). London: Wiley and Sons, Ltd.

Thoman, E. G. (1981). Affective communication as the prelude and context for language learning. In R. L. Schiefelbusch & D. Bricker (Eds.), Early language: Acquisition and intervention (pp. 181-200). Baltimore: University Park Press.

Thoman, E. B., & Trotter, S. (1978). Social responsiveness of infants. Johnson and Johnson Baby Products Co.

Trevarthen, C. (1977). Descriptive analysis of infant communicative behavior. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. London: Academic Press.

Tweedie, D. (1982). Structuring the communication program for the needs of multihandicapped hearing-impaired children. In E. Shroyer & D. Tweedie (Eds.), The mualtihandicapped hearing-impaired child (pp. 185-192). Washington, D.C.: Gallaudet College.

Uzgiris, I. (Ed.) (1979). Social interaction and communication during infancy. New directions for child development. San Francisco: Jossey-Bass Inc.

van Dijk, J. (1965a). Part I: Motor Development in the education of deaf-blind children. Proceedings from conference at the Royal National Institute of the Blind, Denmark. Boston: Perkin's School for the Blind.

van Dijk, J. (1965b). Part II: The first steps of the deaf-blind children toward language. Proceedings from conference at the Royal National Institute of the Blind, Denmark. Boston: Perkins School for the Blind.

van Dijk, J. (1966). The first steps of the deaf-blind child towards language. Paper presented at the conference on the deaf-blind, Denmark.

van Dijk, J. (1967). The non-verbal deaf-blind child and his world: His outgrowth towards the world of symbols. Holland: Institute for the Deaf.

van Dijk, J. (1968). Movement and communication with rubella children. Paper presented at National Association for Deaf-Blind and Rubella children, Holland.

van Dijk, J. (1969). Educational approaches to abnormal development. Holland: Institute for the Deaf.

van Dijk, J. (1978). Paper presented at the Summer workshop for Deaf-blind, Florida State University, Tallahassee.

Wells, G. (1981). Learning through interaction. The study of language development. London: Cambridge University Press.

Willemsen, E. (1979). Understanding infancy. San Francisco: W. H. Freeman and Co.
Yarrow, L., Rubenstein, J., & Pedersen, F. (1975). Infant and environment. Early cognitive and motivational development. New York: John Wiley and Sons.

Zakow, P., Reilly, J., & Greenfield, P. (1982). Making the absent present: Facilitating the transition from sensorimotor to linguistic communication. In K. Nelson (Ed.), Children's Language, Volume 3 (pp. 1-90). New Jersey: Lawrence Erlbaum Associates.

VI. Development of Emergent Language

Kathleen Stremel-Campbell

The dual sensory impairments of a child characterized as deaf-blind often leaves that child with extreme communication and language deficits. A large number of these children also have concomitant handicaps of mental retardation, medical problems, or physical impairments (Jensema, 1979). These additional handicaps, in conjunction with the auditory and visual impairments, have the potential to reduce drastically the child's interactions with his/her physical and social environment. Subsequently, the reduction of environmental interactions can affect the child's language development since the development of language appears to have a cognitive and social basis (Bates, 1976; Bricker & Carlson, 1981; Bruner, 1975a, 1975b; McLean & Snyder-McLean, 1978) in which language develops only after a relatively sophisticated nonverbal communication system has been established through caregiver and child interactions (Mahoney, 1975). The reduction of auditory and visual input would seem to necessitate that children with such dual impairments use somewhat different strategies to learn language. Whether or not these children learn language following major developmental milestones remains questionable. Since there is relatively little data concerning the communication and language development of children who are visually and auditorally impaired, developmental data with nondisabled populations does provide at least one source of data in developing communication intervention programs.

Four major components are necessary for any language system: the modality or the type of communication system (oral, manual, tactual-manual, other abstract symbols), the form (or rules) of the language system, the content of the language, and the communicative use or function. Much of the literature specific to language development for persons with hearing and vision impairments is concentrated in the area of the different modalities or communication systems available (Curtis, 1970; Dinsmore, 1959; Jensema, 1979; Kates & Schein, 1980, 1983). Whereas these documents do provide descriptions of the oral, visual, or tactual modalities, the majority do not discuss the semantic (content) or pragmatic (use) components of language. Recent research with young children without disabilites (Bates, Benigni, Bretherton, Camaioni & Volterra, 1979a; Dore, 1975; Sugarman, 1977) and with children with language delays (Greenwald & Leonard, 1979; Snyder, 1978) demonstrates that intentional communication develops prior to the onset of a symbolic language system. Consequently, children learn to communicate before they learn a language system. Van Dijk's (1967) approach to communication programming with deaf-blind children does focus on a level of prelanguage communication in which both social and cognitive aspects are incorporated into his movement techniques. As discussed in an earlier part of this monograph, (Siegel-Causey, & Guess, 1985) the van Dijk procedures have not yet been validated. However, his work represents the most comprehensive communication/language methodology with children characterized as deaf-blind. Research on the development of the deaf-blind child's communication system and his/her transition into a language system is virtually nonexistent. Therefore, data specific to "what" is taught and "how" it is taught need to be collected.

One of the problems in conducting longitudinal research with children who are vision and hearing impaired is the extreme variability among this population. A total absence of auditory and visual abilities with deaf-blind children occurs rarely (Kahn & Schein, 1980). Therefore, the degree and onset of hearing and vision losses are extemely variable. Additional factors such as, cognitive impairments, motor impairments, and parental interaction patterns increase the variability of children with hearing and vision impairments. Often the vision and/or hearing impairments of these children are not identified until after the child is two years of age (Oregon Deaf-Blind Registry, 1984). The criterion of identifying a child as deaf-blind also often varies across states (NASDSE, 1982). The variability of the child's sensory losses and the age of identification indeed contribute to the difficulty in collecting research data specific to the early communication and language development of these children. It is important that generalizations are not made based on individual case studies with older deaf-blind children having hearing and vision impairments (Rees, Kruger, Bernstein, Kramer, Bezas, 1974; Yarnell, 1980). Children exhibiting more severe hearing impairments rather than vision impairments may acquire language somewhat differently than a child who is blind and has a moderate hearing loss. Therefore, the similarities and differences within a population of children and across different populations may provide new insights in collecting observational data and in designing communication interventions for individual children with sensory impairments.

The following review will summarize: a) earlier and recent models of child language development, b) emergent language development in children with handicaps, and c) emergent language in children with sensory impairments. Within each of these sections the importance of communication intents and early communicative behaviors will be stressed. In addition, the interactive process of receptive and expressive communication prior to emergent language will be discussed. The major topic addressed throughout this review is the process in which a child, characterized as deaf-blind, learns to use symbols to communicate and the type of skills that precede the emergence of symbolic development for the child. Subsequently, four major questions need to be addressed in order to utilize this research in language intervention programs. These questions include: a) How do young children without disabilities acquire a symbolic communication system? b) What are the individual differences in language development? c) Do children with disabilities acquire language in a similar sequence? and d) What adaptations or strategies must be utilized by children with sensory impairments? These questions primarily relate to what to target in intervention programs. Since the majority of deaf-blind children will not acquire language without special intervention, the procedures utilized to train language to persons with severe handicaps also need to be addressed.

The Development of Emergent Language in Children Without Disabilities

Whereas the developmental versus difference controversy of the cognitive development of children with mental retardation is still at issue (Weisz & Yeates, 1981, p. 153), the majority of studies indicate that persons with nonorganic, mental retardation go through the same cognitive developmental stages as do persons without retardation (Taylor & Achenbach, 1975; Zigler, 1969). A number of researchers concerned with the acquistion of language have taken a developmental stance. That is, individuals with mental retardation seem to acquire language skills in the same general sequence as do children without disabilities (Leonard, 1972; Miller & Yoder, 1974) but at a slower rate and only to a lower capacity (Kahn, 1975; Ryan, 1975). Other researchers (Menyuk, 1964; Cromer, 1979, 1981) have indicated that children with language disorders may use or learn language somewhat differently than their peers. Zigler (1967) has stated that persons with organic impairments are different in cognitive development than those persons without organic impairments. Children with organic or sensory impairments may then also demonstrate somewhat different acquisition patterns in developing communication and language. Recently, a number of studies of language acquisition have focused on the importance of individual differences in the language acquisition process (Bloom, 1973; Nelson, 1973, 1974, 1981). Therefore, even though children with handicaps may acquire language in a sequence similar to that of children without delays, there may be different processes that even "normal" (sic) children use as they develop language. The developmental versus difference controversy and the individual difference approach have implications for developing language interventions for populations with severe handicaps.

Ervin-Tripp (1973) describes three general prerequisites for the development of language: a) input from the environment, b) knowledge and understanding of events around the child, and c) perceptual/processing skills. The impairment of the far senses of the child with hearing and vision handicaps does, in fact, affect the way in which these children perceive their environment and possibly the way in which they process their experience and knowledge of the environment. Uzgiris (1981) points out that a functional or organic impairment may reduce the opportunities for certain kinds of experience or interactions within the environment. She suggests that alternative experiential routes and intervention strategies may be necessary rather than trying to fill in the developmental gaps according to "normal" developmental experience. In order to understand the alternative models that children with hearing and visual impairments may need to follow to acquire a communication and language system, it is necessary to review the basic components of language and to describe the cognitive, social, and linguistic processes that children without disabilities experience. Additionally, research on the similarities and differences in the language acquisition of populations that are handicapped, yet nonsensory impaired, can provide data that can be used to formulate research questions that are specific to children with sensory impairments. It is critical that we do not generalize findings across different populations without additional data or careful consideration. Nevertheless, much of the current research has the potential to guide our efforts to analyze how children with sensory impairments may be able to acquire a language system.

Even though a model of "normal" language development can provide insight into the way in which the majority of children learn language, there are a number of language development models. Moreover, the models for language development have changed in the past 25 years. Current longitudinal studies have the potential to further refine and alter theoretical models of language development. In the following sections the major models of language development and corresponding research will be summarized. A major goal of this section is to point out the multi-components of language and communication and demonstrate the complexity of the language learning process.

Models of Language Development

During the 1960's, models for language intervention usually were based on either Chomsky's (1957) model of transformational grammar or Skinner's (1957) functional analysis of language. The transformational model did not take meaning or function into account and implied an innate acquisition device for a child's learning of linguistic rules. Skinner's behavioral model of language was based on the antecedent and consequential events surrounding verbal behavior. The behavioral analysis of language was based on the limited functions of language (e.g., tacts, mand, intraverbals); however, the actual functions proposed by Skinner were limited. In addition the behavioral model did not address the form of language or take the meaning aspects of language into account.

In the early 1970's a number of psycholinguists (e.g., Bloom, 1970; Bowerman, 1973; Brown, 1973; Slobin, 1970) utilized environmental and contextual features to analyze language samples across children of different cultures. It was found that the meaning or "semantic content" of language is related to the immediate environmental context and this later variable should be taken into account when describing a model of language development. Bloom (1970) found utterances may have a number of meanings even though the grammatical rules for those utterances are the same. For example, "No cookie," may mean "The cookie is gone," or "I don't want a cookie." The child's nonlinguistic responses and the context must be taken into account. The results of additional research (Bowerman, 1973; Slobin, 1973) indicate that the meanings or semantic intent implied in children's early utterances are universal across cultures. The semantic model of language acquisition has been accounted for by a cognitive hypothesis (Cromer, 1974). Specifically, it is believed that the acquisition of words and language structures is based on a child's cognitive development. Although the semantic/cognitive model of language acquisition accounts for language being acquired in the context of the physical environment (Bloom & Lahey, 1978), the model does not emphasize the functions or uses of language or the variables of parental linguistic input. Stated otherwise, the social aspects of language development are not taken into consideration in this theory.

The importance of the functions of language acquisition is stressed by Bruner (1974) in a social model of language development. Bruner emphasizes that the context of the language interactions and the partners within the interaction must be considered within a theory of language acquisition. Two of the major aspects of Bruner's theoretical approach (1974, 1975a, 1975b, 1977) are that language meaning and structure are first realized through "joint action" and "joint attention" routines between the child and the primary language model. Both Bruner (1975b) and Bates (1976) focus on the context of early games or routines as the basis for the reciprocity evidenced in later language interactions. Other authors (Halliday, 1975; Lock, 1978; Schaffer, 1977; Ryan, 1974) suggest that social interactions and relationships are the primary basis for the child's understanding of meanings, for the emergence of referential speech, and for the formulation of rules for ordering words. Presently, there is currently disagreement concerning the sequence and importance of early affective behaviors and cognitive development. Lewis, Brooks, and Haviland (1978) suggest that the emergence of affect is based on cognitive development. Conversely, Thoman (1981) argues that behavioral and biological evidence is present to support the position that affective mother/infant behaviors precede and provide the context for early cognitive and language development.

Current theories of language development emphasize the importance of cognitive development (Carter, 1975, Sugarman, 1977) or social development (Bruner, 1975a, 1975b; Bruner, Roy, & Ratner, 1978; Halliday, 1975; and Stevenson & Lamb, 1981). Although the interdependence of social development and cognitive development and the prerequisites of language development currently require additional longitudinal studies among larger groups of children, proponents of current models of language development stress that language is acquired in social situations, fulfilling social goals and expressing cognitive content (Bates et al., 1979a). Consequently, there is general agreement that the development of language appears to have both a cognitive and social basis (Bates, 1976; Bates et al., 1979a).

Bates et al., (1979a) have hypothesized a homology model of language-thought relations in which various domains of activity (cognitive, social, linguistic aspects) share underlying capacities. The authors suggest that the relationship between the activities may be bidirectional rather than directly causal. Bates and her colleagues have conducted a number of longitudinal studies across 25 young children between 9 to 13 months of age (Bates et al., 1979b). Their research comprises perhaps the largest body of correlational data pertaining to the development of early symbolic behavior and language development. Bates (1979a, p. 33) contends that the foundations of early language development are characterized by the onset of communication intentions and conventional signals, and the emergence of symbols and the discovery that things have names. Bates et al. (1976, 1979a) stress the importance of both the social and congitive prerequisites to language. Other authors, in concordance with Bates and her colleagues, suggest that the development of language is based on the convergence of cognitive, social-affective and linguistic processes (Miller, Chapman, Branston & Richle, 1980; Bricker & Carlson, 1981).

Communication Intentions

The shift in the emphasis from a syntatic-semantic model of language acquisition toward more of a pragmatic theoretical model highlights the fact that language is more than words and structure with meaning. From a functional viewpoint there is language as soon as there are meaningful expressions (Halliday, 1975). In intensive studies of the linguistic development of a few children, Dore (1974) and Halliday (1975) found that the transition into a more formal language system is made through the initial use of proto-words (e.g., "da" = want), early speech acts (e.g., gi = give), and one-word utterances (e.g. "dog") that are used to express different communication functions. Bates, Camaioni, and Volterra (1975) have proposed a hierachial sequence of communication development that takes into account behaviors, or speech acts, before proto-words are produced. The three levels proposed by those authors are: perlocutionary acts, illocutionary acts, and locutionary acts. Perlocutions are defined as early behaviors that are produced by the infant and have an effect on the adult. Even though these behaviors are not used intentionally to communicate, the onlooker systematically interprets these early behaviors as purposeful. Brazelton, Koslowski, and Main (1974) stress that it is important for the caregiver to assign meaning to the child's early signals and that parents truly believe that the child's behaviors are intentional. Illocutions are conventional, nonverbal signals that are produced intentionally by the infant to have a specific effect on the listener. These prelinguistic behaviors or acts are used to express a specific function. Sugarman (1977) asserts that the major function of these behaviors are: a) to use a person to obtain an object, and b) to use an object to get a person's attention. These early nonverbal communication behaviors are presumably outgrowths of joint action and joint attention routines between the infant and primary caregiver (Bruner, 1975b). Finally, locutions are conventional symbols (words, signs) that can be used in isolation or in combination to serve a specific communication function (e.g., "more," "more cracker" to request).

For the purposes of utilizing intentional prelinguistic behaviors in communication programs for children with handicaps, it is necessary to define behaviorally an early behavior as an intentional signal. Bates (1979a, p. 35) lists three changes of the child's behavior as evidence of communication intentionality. These involve: a) alternate eye contact between the goal and the adult or checks by the child for feedback from the adult, b) the augmentation, addition, or substitution of signals contingent upon adult behavior, and c) the form of the individual signals. It may be necessary to re-define Bates' criteria before using those criteria of intentionality with children having visual impairments since eye contact may not be possible. It is essential that orientation or some form of recognition of the adult as an agent or as a means to a goal be demonstrated by the child. Even though a number of persons define communication differently (See Thoman, 1981), Schaffer (1977) proposes that the constituent skills for communication are intentionality and role alteration. Both Bates et al. (1979b) and Sugarman (1977) have pinpointed the beginnings of intentional communication with children who are not disabled at between 9 months and 13 months of age. Nonsocial tool use also appears at about nine months as well. At this point in development, the form of the child's signals change in shape and become used more regularly.

Early communication functions used by children. The specific communicative intentions expressed in early child prelinguistic and linguistic development have been categorized differently by a number of persons (Dore, 1974; Carter, 1975; Halliday, 1975; & Moerk, 1977). The majority of taxonomies of communication functions are based on the child's utterances, nonlinguistic aspects surrounding the utterance, and the environmental context. Dore's definitions (1974) of pragmatic functions (request action, protest, calling, request attention, etc.) are also based on the adult's response to the child so that the functions are defined on the entire communication interaction. Halliday (1975) found that four functions, such as regulatory (do what I say), instrumental (get what I want), personal (see me, see what I see), and interactional (you and me) are used before the heuristic, imaginative, and informative functions. These later functions are observed to occur prior to dialogue in which the child responds specifically to a question (when the information is not known by the listener), or responds to a statement, or responds to a response. Halliday's (1975) analysis of proto-words, one-word utterances, and multiword utterances show that specfic words are first used to express a single function whereas different words express other functions. Later, a word is used to express multiple functions. The development of two-word utterances seem to follow a similar pattern.

Early communication functions addressed to children. There are relatively few studies concerning the types of pragmatic functions that are addressed to young children or of pragmatic functions that are first comprehended by children at the prelinguistic level (Maser, Holzman, & Ferrier, 1977; Sherrod, Crawley, Petersen, Bennett, 1978). Studies are available (Chapman, 1981; Folger & Chapman, 1978; Moerk, 1975; Rondal, 1978) that concentrate on analyzing mother's speech and pragmatic use of communication when children begin to use language (19 months and older). Although the literature on child development contains numerous studies that demonstrate that young children respond to intonational contours, suprasegmental features, facial, and other gestures prior to words, the specific pragmatic functions of the nonlinguistic input have not been analyzed. Thus, it seems that children who are severely hearing and vision impaired may have difficulty expressing different pragmatic functions if they are limited in comprehending the communication intent of others through an inability to see facial and gestural communication or to hear the intonation patterns or pauses in the turn-taking routines. Mahoney (1975) proposes that for language to develop effectively, children must be able to detect meaning by some nonverbal means. Consequently, parents must also be able to determine from nonlinguistic cues that their attempts to communicate are not too complex for the child. These perspectives suggest that it is equally important that the prelinguistic signals directed to the child and the child's response to those signals be addressed in intervention programs for the deaf-blind child.

Conventional Signals

Intentional communication expressed through conventional signals is viewed by Bates (1976) and Bates et al. (1979a) as a process that proceeds, correlates with, and eventually contributes to the emergence of symbolic communication. It is important to note that prelinguistic (prelanguage) communication signals are not symbols. These authors found that a subset of prelinguistic communicative measures predict the emergence of symbols in both language and play. Their longitudinal research data with 25 children indicate that the emergence of symbols is correlated with imitation, tool use, manipulative play, and the frequency and sophistication of preverbal communication. Specific preverbal communication acts include showing off, giving objects, showing objects, communicative pointing, and ritualized requests. Out of the gestural communication complex, communication pointing seems to be the best predictor of symbolic language and is also one of the later gestures to develop (Bates et al., 1977). The cognitive schemes of means-ends, imitation, and manipulative play are also related to gestural communication. The young child's gestural communication system expands and conventional signals are used more regularly during a four-to-five month period before the child transitions into symbolic communication. Early symbol use does not replace gestural communication, rather, conventional signals continue to increase as language emerges (Bates, 1975, 1979a, & 1979b).

The approach of Bates et al. (1977, 1979) does not imply that sensorimotor skills precede social-communicative behaviors. Rather, the construction of operative-schemes characterizing interactions with both social and physical objects/events may serve as a prerequisite to social, cognitive, and language development. Earlier research by Sugarman (1973) supports the continuity from precommunication behaviors to communication behaviors. Sugarman found that early physical actions and social actions correspond to Piaget's (1962) sensorimotor stages. During Stage III children demonstrate separate and simple actions on objects or actions on people. Within Stage IV, more complex schemes are demonstrated; however, the actions on object or persons are not combined. Only during Stage V are objects used to obtain the attention of the onlooker and are persons used to obtain an object. Ingram (1981) investigated the early language development of three children. He found that although two of his subjects did not demonstrate symbolic communication until Stage VI (similar to the results of Bates et al., 1979a), a third subject began using language without acheiving Stage VI schemes in tool use, imitation, and play, indicating that these behaviors may not occur prior to language for some children.

A few studies have investigated the pragmatic functions of mothers' language to the child prior to the child's development of words (Freedle and Lewis, 1977; Sherrod et al., 1978). Mothers seem to use more effective speech at four months with more comments directed to the infant's condition (i.e. "Are you hungry?"). Within the next four months mothers change their speech style with eight month olds in that more meaningful speech is used, consisting of commands and requests for direct attention in specific interactions (e.g., "Tony, look here."). One could speculate that the child's increase in motor development and intentional behavior is responsible for the shift in how mothers generally communicate to their children. The infant's level of receptive language and preverbal behavior would seem to have a dramatic effect on maternal language prior to the child's entry into a productive language system.

Research on mothers' responses to their children's prelinguistic communication (Masur, 1981) demonstrates that mothers respond more consistently to the child when the child extends objects, but respond differentially to the child's pointing by providing a label. The strong demand quality of gestures toward the listener plus the contextual nearness of the object may account for the earlier presense of giving and showing objects and the later development of pointing. Masur's (1981) work and research by Corsaro (1981), and Messer (1978) highlight the possible impact of mothers' responses to early gestures upon the transition into language or referential communication. Ninio and Bruner (1978) report that mothers respond consistently to their infant's pointing by labeling pictures in book-reading routines. The results of a study conducted by Messer (1978) indicate that the manipulation of a toy during joint attention routines were synchronized by maternal reference to that toy, thus, providing the infants with information about that object. Pointing to distant objects (Murphy & Messer, 1977) is another strategy that integrates the mother's and the infant's attention to important features of the environment. The sensitivity and synchrony that mothers use to respond to their infants' nonverbal behaviors during joint activity indicate that the social interaction between the mother and child would seem to contribute to the child's movement into a symbolic communication system. The effect of the mother's speech on the prelinguistic and linguistic development of infants and the circular effect of the infant's nonverbal interactions on maternal input has important implications for both the assessment and intervention of infants with sensory impairments.

The research reviewed in this section indicates that the child's prelanguage behaviors should not be assessed in isolation. Instead, these behaviors are measured best during the critical mother-child interactions. While the broad categories of prelanguage behaviors or gestural communication do provide a sequence for training (e.g., extending objects prior to pointing), severe visual impairments may limit the child's capacity to engage in communicative pointing. Additionally, hearing limitations reduce the early vocalizations and protowords that serve early communication functions. Alternate strategies of distancing the referent from the child's immediate contact may be necessary before the child is ready for a symbolic system.

Emergence of Symbols

The sequence of behaviors preceding symbol use has implications for the emergence of more concrete symbols, as well as for the more abstract symbols. The emergence of the first words (or first signs) is not necessarily the beginning of symbolic communication. As discussed earlier, the emergence of symbols seems to be preceded by the interdependent development of tool use, imitation, and preverbal communication. In summarizing their data, Bates et al. (1979a) have proposed a critical threshold model between imitation, tool use, and communicative intent in which all three behaviors must reach some level of complexity before symbolization occurs. Unfortunately, it is not known what these specific threshold levels are. The data suggests that the transition into symbolic communication is a gradual process in which protowords or wordlike sounds serve specific pragmatic functions (Dore, 1975; Halliday, 1975). Subsequently, vocalizations approximating adult-like words are used within functional, routine activities. At this point the word may be tied more to the routine itself than to a specific referent (Bates et al., 1979a). Next, referential words are used within a range of contexts. Only at a later point is the word or symbol distanced from the referent in that the referent does not have to be immediately available (Bates et al., 1977; Bates et al., 1979a). This concept of distancing the signal from the person-object referent is defined as "decontextualization" by Werner and Kaplin (1963) and discussed in detail by Bates et al. (1979). Volterra, Bates, Benigni, Bretherton, and Camaioni (1979) observed that words (symbols) and symbolic gestures with objects (in play) follow a similar pattern of acquisition in that the distancing from the referent or from the object (in symbolic play) occurs in both language and play. Therefore, development within nonsocial activites seems to be associated with developmental parallels in referential communication. However, children do not seem to demonstrate gestures without acting on the object in some way. Bretherton, Bates, McNew, Shofee, Williamson, and Beeghly-Smith (1981) found that gestural symbolic acts were used more frequently by children at 13 months and that object labeling was used more frequently at 20 months. The results indicate more of a preference or ease at using gestures at 13 months rather than a developmental sequence.

Prelinguistic communication does not seem to decrease as children acquire their first words. Rather, more prelinguistic gestures are added to the child's repertoire as they begin to use words. At the same time, children also increase their use of symbolic gestures (as a toy phone to their ear) while using first words (Volterra et al., 1979). Data from a longitudinal study by Volterra and her colleagues indicate that children

(9 months to 13 months) may use similar vocabularies, either in gestural naming or in verbal naming. By testing, maternal interview, and observation it was demonstrated that children use gestural names concurrently with verbal names. Either a gestural symbol or a vocal symbol is used to identify or request a referential object, event, or activity. The continuity of language development remains as more referential words are acquired by children. As children's vocabularies develop, nonreferential words (mama) are added as the referential words (cracker) increase.

The overlap and continuity between gestural communication to nonreferential words and to referential words demonstrated by children who are not disabled provides insights into the establishment of criterion in intervention programs. Even though most children use words (and play) as their first symbolic behavior, the first representations used by children with severe vision and hearing impairments may not be abstract speech words or signs. Rather, more concrete objects, gestures, and object representations may need to be trained before the deaf-blind child is able to understand and use more abstract symbols. Moreover, if young children express varying levels of communication and language within the acquisition process, we should not demand children with sensory handicaps to make a sudden and total shift into another form of communication or language. For example, even though a child may use a few signs, additional prelanguage gestures may be targeted within an intervention.

Early Comprehension and Imitation

The roles of both comprehension and imitation in the language acquisition process have been debated by numerous researchers (e.g., Brown & Bellugi, 1964; Bloom, Hood, & Lightbrown, 1974; Clark, 1977; Dale, 1976). Uzgiris (1981) proposes a different role of imitation within language acquistion, suggesting that imitation or joint executions of action may have a communication function in that it may create the context of mutuality between the infant and partner. Kagan's (1976) description of imitation is similar to that proposed by Bates et al. (1979a) in that in the early stages of language development, children do not imitate something that is not familiar to them. In general comprehension of words proceeds production (Nelson, 1973). Additionally, children often imitate words that they comprehend or that they are in the process of acquiring. Children between 9 and 13 months do not seem to imitate words that they do not comprehend or are not beginning to produce spontaneously (Volterra et al., 1979). These findings differ from Piaget's (1962) levels of development in the Imitation schemes.

Types of First Words

The types of words that children acquire before using multiple-word utterances (Nelson, 1973) and those recommended for language training considerations (Holland, 1975; Lahey & Bloom, 1977; Karlan & Lloyd, 1983) are based on a similar criterion. Overall, children first learn words that have communicative value and occur in the "here and now" (Lahey & Bloom, 1977). Moreover, the majority of first words accompany the child's actions on objects (Greenfield & Smith, 1976). The primary attribute of the first words that children learn is that they have a similar property of change or move in some way. These include words for (or specific to) food routines, people, animals, or toys. First words also include those that accompany action schemes with persons and objects and that are names for persons or objects acted on in familiar games and routines. In summary, children use words in the following sequence: 1) as a procedure or to stand for a routine, 2) to announce an anticipation of a routine or interaction, 3) to designate actions carried out by himself or others, and 4) to categorize persons, objects, or events with decreased contextual support (Volterra et al., 1979, p. 175-6). The child's first words (symbols) initially are tied directly to the visual content and gradually are used to express context that is not immediately visible or connected directly to familiar routines (decontextualization).

Individual Differences in Language Development

Recently, attention has been directed at the differences that individual children bring to the task of acquiring and expanding their initial language. In a longitudinal study with presyntactic children, Nelson (1973) found that children evidence individual approaches to language learning. Her major finding is that some children use early vocabularies consisting of a large number of clearly articulated nouns. These children are termed "referential" communicators. Other children use more phrases within social routines. This type of child imitates more readily (Bloom, Hood, Lightbrown, 1974) and uses a large number of pronouns, whole phrases, and poor articulation (Nelson, 1981) as well as uses different intonation patterns (Dore, 1974). These children are labeled "expressive" learners. Other findings by Nelson (1973) indicate that children acquire language more rapidly when there is a match between mother and child styles. For example, children who label objects and events in a manner similar to their mothers, rather than using more social phrases, acquire later language milestones more rapidly. From the results of the preceding investigations, it can be concluded that rates of early productive language acquisition do not seem to predict later language development; rather, levels of comprehension and mother-child interactions do seem to be strong predictors of later language development (Nelson, 1973; 1981). Additional evidence (Peters, 1977) suggests that the environmental context may play an important role in that children may demonstrate either one style or another but within different contexts.

Summary

Recent theorectical perspectives and research in language development have the potential to provide general input into communication interventions for populations with handicaps. The major findings discussed within the previous section are summarized below.

1. Early language development has both a cognitive and social basis.
2. Children express some forms of communication intent prior to the development of a language system.
3. Imitation, tool use, and play skills are interrelated with the emergence of symbols.
4. Mother-child communicative interactions are important to the child's language development.
5. Children express some early gestural communication before using words. The sequence of development include: showing off, giving/showing, communicative pointing, with communicative pointing being the best predictor of language development.
6. Children seem to develop different styles of communicating during the early phases of language development.
7. Children seem to imitate words that they comprehend or are beginning to use.
8. Children first use words that "stand for" a routine interaction. Words then go through a gradual process of "decontextualization" in which children are able to use words differently for objects that are not visible.

A number of the preceding results may be more applicable to intervention programs than others. Further, a number of adaptions may need to be made before these findings are integrated into interventions for children with auditory and vision impairments.

The Development of Emergent Language in Children with Handicaps

The extensive body of research data collected by Bates and her colleagues (1975, 1976, 1977, 1979a, 1979b) specific to the relationship of cognitive, social, and linguistic skills prompted a number of studies to determine if children with handicaps develop language in a similar sequence and manner as children without disabilities. Earlier work that focused on the uses or functions of language (Bruner, 1975; Dore, 1975; Halliday, 1975) changed the focus of many communication programs for children with delayed language or other handicaps. Snyder's (1975) research was one of the first studies to systematically investigate the relationship of cognitive and linguistic development with language delayed children. Until that point many persons speculated that object permanence was a critical precursor to language development. The results from Snyder's study demonstrate that means-end (tool use) skills are correlated significantly to the emergence of language with children who are language delayed. She also found that children utilized gestures more frequently than linguistic forms even though the children could produce the linguisitc forms.

In general the majority of research in language development with children who are delayed has been conducted with children who have language delays or who have Down syndrome. The three major lines of research to be addressed within this section include: a) the relationship of cognitive skills and language development, b) the sequence and use of prelinguistic and linguistic communication, and c) the development of communication functions. The major question addresses whether or not children who are delayed or handicapped learn language in a sequence similar to children without apparent handicaps.

In a replication of Snyder's study (Rowan & Leonard, 1981) contradictory results were found. Children with langauge delays and the children without disabilities expressed primarily imperative (requests/commands) and declaratives (label/commands) by words rather than gestures. In an earlier study with a different population (Greenwald and Leonard, 1979) results indicated that children with Down syndrome and a group without disabilities developed gestural and linguistic communication similarly. However, the older children with handicaps used words at Stage V even though the younger children were not using words.

Recently, a number of studies (Fey, Leonard, Fey & O'Connor, 1978) have investigated the development of communication functions or uses (pragmatic ability) in relation to other linguistic abilities (mean length of utterance and semantic relations) with children with language impairments (Leonard, Camarata, Rowan, & Chapman, 1982; Rowan & Leonard, 1981; Snyder, 1975) and with children with Down syndrome (Coggins, Carpenter & Owings, 1983; Marshall, Hegrenes & Goldstein, 1973; Owens & MacDonald, 1982). The study conducted by Leonard et al. (1982) examined the communication functions of two groups of children: those with language impairments and those without disabilities. The children with language impairments appeared to exhibit communication functions that were consistent with their level of lexical development. One difference was noted in that naming was used more frequently by the children without disabilities, and answering was used more frequently by children in the other group.

Overall, studies investigating the development of communication functions (e.g., request, label, protest, answer, etc.) specific to children with Down syndrome have revealed no sigificant differences between children with Down syndrome and children without apparent handicaps. Studies that matched children on mean length of utterances at different stages (Owens & MacDonald, 1982) and on both cognitive and language levels (Coggins, Carpenter & Owings, 1983) confirm these results. The majority of the studies with children displaying language impairments and Down syndrome were matched on language ability and not on age variables when compared with children without disabilities.

Studies investigating communicative ability with populations with hearing impairments (Curtiss, Prutting & Lowell, 1979), children with autism (Bernard-Opitz, 1982; Curcio, 1978; Prizant & Duncan, 1981; Prizant & Rydell, 1981; Wetherby & Prudding, 1984), and children with severe/profound mental retardation (Cirrin & Rowland, in press; Lobato, Barrera & Feldman, 1981) have produced mixed findings in regard to: a) the level of prelinguistic and linguistic ability compared to sensorimotor stage functioning and b) to the types of communication functions compared to prelinguistic and linguisitc ability. Subsequently, there seems to be general agreement that children with similar linguistic and cognitive abilities demonstrate comparable communicative behaviors that serve a number of different functions (e.g., request, protest, answer, request information). However, children with severe handicaps who are at the prelinguistic communication level appear to be rather restricted in their use of communication functions compared to the results with nondelayed children (Bates, 1976; Halliday, 1975; Sugarman, 1977).

Cirrin and Rowland (in press) assessed the communicative behaviors and functions of 15 nonverbal youths with severe/profound retardation. All of the youths, even those with severe social and cognitive impairments, exhibited a number of communication behaviors and functions. The youths were divided into low and hi communicators based on the frequency of use of communicative behaviors. The group with low frequencies of communicative behaviors used fewer types of communicative functions (requesting action/object, protesting). This group also demonstrated fewer and less conventional communicative acts (pushing away, extending object). Youths with higher communication rates were more flexible and diverse in their use of the types of conventional prelinguistic and linguistic (signs) behaviors and in the functions those behaviors expressed. The investigation by Lobato, Barrera and Feldman (1981) also included youth who were older (mean of 13 years) and institutionalized. The study examined communicative behavior in sensorimotor stages IV, V, and VI. Their data support the results of Sugarman (1977) and Bates et al. (1979a), indicating an interdependence between cognitive and communication functioning. However, Labato et al. (1981) found that there was variability in the communicative functions in that only approximately 23% of the youths used equivalent stage communicative gestures for both declarative and imperative functions. The remaining youth demonstrated better performance on the imperative than on declarative functions. Snyder (1978) also reported that children with language delays demonstrated higher performance levels on the imperative (request, demand) tasks.

Studies in which the gestures of autistic children were examined (Curcio, 1978; Wetherby & Prutting, 1984) revealed that factors other than cognitive development may play an important role in language acquisition. Curcio (1978) found that children with autism display request, refusal, and greeting, but do not demonstrate pointing or showing to express comments or to direct another's attention to referents. The data indicate that many of the gestures used by the children represent contextually restricted communicative behaviors (manipulating the adult's hand). The results of a study by Wetherby and Prutting (1984) are consistent with Curcio's findings. Data sources of cognitive assessment and communication assessment show that their subjects demonstrate strengths in tool use, but weaknesses in symbolic play and conventional gestures. Additional findings indicate that the requesting function (imperative) is utilized significantly more frequently than the commenting/label (declarative) function. Wetherby's and Prutting's (1984, p. 376) concise statement accurately describes the communicative behavior of nonverbal children and youth with more severe handicaps, "The children were proficient in figuring out how the environment works, but deficient in sharing that knowledge with others or in acquiring that knowledge from others."

Marshall, Hegrenes, and Goldstein (1973) also examined the communicative performance between mothers and their children (handicapped and nondelayed) using Skinner's (1957) verbal operants. Two groups of children were matched for chronological age but not linguistic ability or mental age. The results suggest that mothers of children with retardation "manded" (demand and commanded, requested, gave directives) with a much higher frequency than the mother's of nondelayed children. The nondelayed children used tacts (labels), mands (demands, commands), and intraverbals (questions) more frequently than the children with delays. The delayed group used a higher proportion of echoics (imitations of previous words or utterances). Surprisingly, based on the data presented earlier, both groups used more tacts (labels) and intraverbals than mands (imperatives). Since Skinner's operants are broad categories of functions, it is difficult to draw direct comparisons between this study and the previous studies.

A more recent study with young children without delays by Coggins, Carpenter and Mastergeorge (1981, cited in Cirran & Rowland) examined the communicative functions of 8 to 15 month old infants. Results show that the request or imperative functions seem to emerge earlier than the declarative functions. Although more conclusive data with young children need to be collected, these results indicate that the development of pragmatic functions may be more heterochronous than earlier data (Bates et al., 1975; Bates, 1976; Sugarman, 1977) seem to indicate.

Many of the previous studies did not investigate different communication performance across different persons or different environmental contexts. A number of authors (Bernard-Opitz, 1982; Schuler, 1979) stress the importance of studying communicative performance as a function of the communicative context. Future research studies examining communicative performance must take into consideration that children communicate differently with different people across different activities in different settings. Further, many children with handicaps have been in intervention programs for a number of years. The effects of specific types of interventions and the effects of institutionalization on communicative performance need to be considered in addition to the child's cognitive and social abilities.

Modality Performance

Even though speech and signing are not the only communication systems available to young children with sensory impairments, studies specific to the visual-gestural systems (visual-sign) and the aural-oral (hearing-speech) systems are much more prevelant than tactile-kinesthetic (touch-sign, object-tactile) systems. Often, tactile-kinesthetic systems, such as touch cues, touch signs, object systems, morse code, and braille are the primary communications systems of persons with severe sensory impairments. Yet, data is not available that traces the development of symbolic systems other than speech-words or signs. Moreover, the development of signs as an emergent language system is just beginning to be investigated more systematically.

Volterra et al. (1979) found that children do not produce symbolic gestures without acting on the objects. They found that it was no easier for children to acquire an arbitrary gesture than to acquire an arbitrary sound. In fact, Bretherton et al. (1981) suggest that the decontextualization of the symbol and referent may be more difficult in the gestural modality than in the vocal modality. These findings may be applicable only for hearing children reared in an auditory environment. Prinz and Prinz (1979, cited by Miller, 1981) followed the development of a hearing child reared with a hearing parent and nonhearing parent. Findings revealed that the child developed manual and verbal English at the same rate. Studies investigating the acquisiton of manual signs with children who are deaf report equivalent acquisiton (Newport & Ashbrook, 1977) or more rapid acquisition of manual communication. A series of articles (Bonvillian & Orlansky, 1984; Bonvillian, Orlansky, & Novack, 1983; Bonvillian, Orlansky, Novack, & Folven, 1983) reporting on a longitudinal study with young children of deaf parents present data that indicate that the majority of their children expressed linguistic performance in advance of their cognitive skills (eight to nine months). Findings indicate prelinguistic gestures (pointing, giving, showing) did not occur prior to linguistic-sign development, but rather co-occurred with the frequency of each being directly interrelated. Studies by Bonvillian and Nelson (1978) and Wilbur (1979) also reported that hearing infants exposed to manual signs begin to express manual signs before vocal words.

In summary, whereas young children without hearing impairments do not use symbolic gestures (hand to mouth to represent drink), to communicate, children with hearing impairments seem to acquire symbolic gestures (signs) quite readily. These findings perhaps point out the effects of specific training, parent input and the plasticity of human development.

Linguistic Performance

There is general agreement that delayed and nondelayed children matched for mean length of utterance demonstrate comparable levels of semantic and syntactic development (Coggins, 1979; Ingram, 1972; Rondal, 1978). The results of these studies suggest that, overall, children with language impairments and retardation learn language form and content in the same general progression as children without delays - only at a slower rate and often at a lower ceiling. A more recent study by Mahoney, Glover, and Finger (1981), though, indicates that young children with Down syndrome performed lower than their overall sensorimotor scores would indicate in the areas of vocal imitation, receptive language, and in the acquisition of first words. These findings tend to agree with those of Bates et at. (1979a) in that children may have to reach specific levels of imitation, tool use, and gestural communication before symbolic communication occurs. Moreover, their findings that children often imitate what they comprehend and Nelson's (1981) report that comprehension is one of the major predictors of language acquisition would seem to support the Mahoney et al. (1981) findings. Lower vocal imitation functioning may be a result of lower receptive language acquisition rather than general sensorimotor functioning.

Research on the language development with young children with handicaps indicates that children with moderate handicaps learn language in a sequence and manner similarly to children without handicaps. Studies by Snyder (1975) and Mahoney et al. (1981) reveal that some differences in development may occur. It is important to note that children with handicaps may also present dramatically individual differences with dramatically different social-familial experiences and intervention programs. Additionally, many children with Down syndrome and language delay may also exhibit mild auditory and/or visual impairments. There is the probability that deficits in perceptual development may affect the social development as dramatically as cognitive development. The dual deficits in both social and cognitive development create the need for more individualized assessment and intervention procedures.

The limited research findings with children with more severe and profound handicaps reveal that these children tend to demonstrate somewhat different developmental learning strategies. For example, communication functions and the types of prelinguistic behaviors seem to be somewhat restricted. Additional data with younger children (six to eight months) without handicaps may point out that young children also exhibit more restricted forms than the current research indicates, but that they progress through early communication functions and types of behaviors very rapidly. Therefore, it is difficult to document these differences in the sequence of development.

Due to the passage of Public Law 94-142 and permissive and mandatory state legislation for toddler and preschool children, few children with handicaps are acquiring communication and language outside of intervention programs. Therefore, it is difficult to determine if children with more severe handicaps learn differently due to their handicapping condition, due to intervention procedures, or if additional data with children without apparent handicaps is needed.

The Development of Emergent Language in Children with Deaf-Blindness

Jensema (1979) reports that approximately 75% of persons characterized as deaf-blind display cognitive deficits and that approximately 65% have at least one additional handicapping condition. Developmental data for deaf-blind children and youth (7-21 years) from five states were analyzed across a three-year period by the Mountain Plains Regional Center for Services to Deaf-Blind Children (Snyder & Yoshinaga, 1982). Results indicate that the children/youth made progress in perceptual development and daily living skills, but made extremely limited progress in language and social development. The vast majority of children with a combination of hearing and visual impairments experience severe communication difficulties (McCormick, 1984) and seem to make limited progress in developing language skills. The few studies reporting the communication-/language progress of persons with dual sensory impairments have been conducted primarily with older persons (Curtis, 1975) or include only case studies (Yarnell, 1980). Research data investigating the late prelinguistic communication systems and the emergent language systems with young children who are deaf-blind are virtually non-existent. Data specific to the rates or stages of language development with hearing impaired children (Brown, 1977; Moores, 1977; Schlesinger & Meadows, 1972; Wilbur, 1976) and visually impaired children (Fraiberg, 1971, 1977; Rowland, 1984a; Urwin, 1975 - cited by Bates et al. 1979a; Warren, 1977) are also somewhat limited. The results of the majority of studies with hearing impaired infants suggest that these children, as a group, develop their first words (signs) at approximately the same rate or earlier than children without impairments.

The majority of children with severe visual handicaps eventually develop language skills comparable to their peers, even though they initially demonstrate significant differences in the rate at which they acquire language (Warren, 1977). Urwin (1975; cited by Bates et al, 1979a, p. 285) reports that the limited ability of a blind child to perceive visual stimuli has an effect on the form and content of early language utterances. In a study investigating the preverbal communication system of blind infants, Rowland (1984a) found that while the frequency of the infant's vocalizations were similiar to those of sighted infants, the vocal patterns did not show clear patterns of responsiveness. In addition Rowland investigated mother interactions with their visually impaired infants in videotaped interactions. She found that mothers did not respond reliably to infant's gestures or vocalizations. Fraiberg (1971, 1977) found that in the absence of differentiated facial signs, blind infants use expressive hand signs. However, only 20% (n = 2) of the 10 mothers in her study, responded to the infant's unconventional signals without specific training. The results of these studies suggest that even though the end product of language may appear to be similar to "normal" development, the process of language development may be somewhat different.

With the exception of Stein's (1982) review of language development of deaf-blind children across a seven-year period, the majority of the literature specific to children with sensory impairments concentrates on the numerous communication systems available to deaf-blind children and adults (Dinsmore, 1959; Jensema, 1979; Kates & Schein, 1983). Kramer and Rosenfeld (1975) list four criteria for consideration in selecting communication systems for persons with dual sensory impairments. Those criteria include a) the age of onset and severity of the hearing impairment and b) age of onset and severity of the visual impairment. The severity of mental retardation would also seem to be an extremely important variable in selecting a specific symbolic language system. Jensema (1981) conducted a national survey with teachers of sensory impaired children. Her results indicate that the severity of visual impairment is a more reliable indicator of a preferred method of communication than intelligence quotient. Students with even moderate to severe vision impairments preferred visually presented gestures (signs) over aural-oral approaches according to the teacher's reports. Approximately 20 different systems (e.g., fingerspelling, cross-code, morse code, one-hand/two-hand touch signs, Tadoma, bliss symbolics, palmwriting, etc.), excluding different types of electronic augmentative systems, are available as communication systems to persons with sensory impairments (Kates & Schein, 1980). As a child with sensory impairments develops language, he/she may know and use as many as five different systems (Yarnell, 1980). Curtis (1975) studied 20 deaf-blind children and found that auditory-receptive and oral-expressive skills were the lowest language skills demonstrated, with visual-tactile-kinesthetic based systems being superior to oral-aural systems. Additional results indicated that the majority of children were most deficient in communicating in unstructured situations. These data stress the importance of familiar and routine situations for early intervention and also for more active generalization strategies to facilitate generalization to more unfamiliar situations.

A number of authors (Kennedy, 1974; Shields, 1972; Rogow, 1980) discuss the importance of the social aspects of development and its important role in the development of early communication for sensory impaired youngsters. Kennedy (1974) defines two important components to the acquisition of communication as the awareness of communication of others and consistent behavior of adults to the behaviors that communicate. However, documents and articles discussing the development of communication and emergent language systems with children identified as deaf-blind have not included supporting data.

In addition to the use of more precise measurement systems, a number of other variables must be addressed before more individualized communication and language systems for deaf-blind infants and children can be developed. More precise assessment of hearing acuity, visual acuity, tactile sensitivities, and cognitive development need to be conducted and clearly documented for individual children with sensory impairments before we learn how these children acquire a prelinguisitc and emergent language communication system. The review of the literature with children who are nondelayed or who do not exhibit dual sensory impairments perhaps poses more questions than answers. However, the literature does point out that specific levels of interaction and knowledge of the social and physical environment are usually present before the majority of children evidence prelanguage communication skills and language skills. Other important points are the gradual progression of emergent language acquisition, the possibility of the interdependence of seemingly nonrelated skills, and also the individual differences of acquisition styles among all children. The literature with children who do not exhibit disabilities also emphasizes that the development of communication functions/uses and prelanguage communication need to be addressed prior to issues specific to concept development, content, modality, and form.

Communication Skills Center Current Research

The remainder of the review will address questions based on preliminary data of children birth to five years who are sensory impaired and will provide a discussion of a number of language patterns that are exhibited often by older deaf-blind students. Those of us involved in developing intervention programs for these children are faced with three major questions: a) are these children evidencing error patterns that may interfere with later development? b) are they demonstrating intermediate stages and a much slower development pattern than evidenced by other children? or c) are environmental variables affecting the communication patterns of the deaf-blind children?

The Portland Public Schools and the Teaching Research Center Sites of the Communication Skills Center for Deaf-Blind Children, birth to five years, currently are conducting longitudinal assessment and intervention programs for 10 deaf-blind children. As with all children identified as deaf-blind, the participants within the Center demonstrate communication skills as variable as the children themselves. Nevertheless, at different stages of development, a few specific patterns of communication functioning have been observed. A battery of assessments have been conducted with each of the children with different levels of hearing and visual impairments. In addition to the administration of the Callier-Azuza assessment (Stillman, 1978) and prelanguage and language communication assessments (Stremel-Campbell, Clark-Guida, & Johnson-Dorn, 1984), a series of sensorimotor tasks have been video taped at regular intervals. A communication matrix (Rowland, 1984b) has been developed to assess the children's nonintentional behavior, intentional behavior that communicates, prelanguage behaviors, and language behaviors expressing different communication functions. The communication matrix is completed on each child at six month intervals. During the first year of the project, weekly prelanguage/language communication-observations (Stremel-Campbell, Johnson-Dorn, Clark-Guida, & Udell, 1984) were collected across both food related and nonfood related routines within the classroom setting. At this point, data collected from these instruments has provided only preliminary results. These data do provide a general sequence of prelinguistic development and communication functions and also provide a direction for research and intervention.

Prelinguistic Communication Development

Initial pretraining assessment data of the children at the prelinguistic stage of development suggest five major characteristics: a) the restricted use of different types of prelanguage behaviors or acts, b) the lack of perseveration in prelanguage use to reach a goal, c) the limited use of different communication functions, d) the lack of generalization of one type of prelanguage behavior (such as extending objects) across different routines, e) the limited comprehension of prelinguistic communication presented to the children by others, f) the lack of progress in the development of a symbolic communication system, and g) the infrequent opportunities to communicate provided by the environment. The majority of prelanguage behaviors demonstrated initially by the children who were expressing intentional prelanguage consisted of behaviors in which the children directly manipulated the adult to request or protest an action or an object. These observations are similar to Curcio's (1978) findings that children with autism exhibit contextually restricted gestures. The literature points out that children without disabilities demonstrate body movements to "show off" or to obtain adult attention. Even though children without disabilities do manipulate adults to request, this act does not seem to be a major stage of development. Moreover, children with sensory impairments seem to have difficulty in "distancing" themselves from a person to reach a goal. Once the child learns that people can serve as agents and be used as tools, there seems to be a reliance on the direct connection between the child, the adult and the goal, even when the object is present (and vision is sufficient) for "giving or extending."

At this point it is difficult to determine if the children have not learned to utilize their functional vision within the request function for more contextually removed gestures, if they have not learned the associations between objects and potential agents, or if the children are actually using the person as more of a physical tool rather than a social tool. Overall, the children seem to use the person directly to get an object or action prior to using an object to request in a more indirect manner. The children within the project also tend to use early prelanguage acts to request continuation of an object or action for a period of time before they will request an action without the adult beginning that action. Bates et al. (1979b) points out that, as children become more intentional in their communication efforts they augment, add, or substitute their signals if their goal is not attained. Although more precise measures need to be developed to adequately assess the deaf-blind child's persistance to achieve a goal, video taped sequences appear to demonstrate that these children often give up or resort to seemingly more inappropriate behaviors to achieve their goal instead of modifying their early signals.

Even when the children in the project learn to extend objects, they extend or give them soley as a request or as a protoimperative. The majority of children do not seem to use a prelanguage gesture for the multiple functions of showing or protodeclaratives (early labels/comments) as described by Bates (1975) and Sugarman (1977). It is possible that the lack of (or limited use of) protodeclaratives may be a function of the child's environment or intervention. This absence may also be a function of the child's level of social development in that 'declaring' may serve more of a social purpose. Prelanguage gestures, such as extending or giving objects, form a response class in that the behavior of extending can be used with a number of objects; however, a number of the project children have not generalized the extending gesture to nonfood activities without specific training within those activities. Therefore, they demonstrated a restricted use of the behavior, specific to only certain environmental contexts.

Bates (1979b) discusses thresholds of specific cognitive behaviors (tool use, imitation, manipulative play) and prelinguistic gestures that seem to be interrelated with the emergence of langauge. Our intervention data during the first year, as well as previous training data, indicate that although a number of deaf-blind children do express limited prelanguage communication behaviors, they do not learn the referential function of symbol to referent in an isomorphic (i.e., one to one) correspondence. Rather, the children seemed to use a sign to express a general request "(I want)" function. A newly trained sign would replace the first sign that was trained and serve the same function. The children do not seem to learn to differentiate the sign-object relationship. Two of the children have demonstrated this pattern of acquisition repeatedly throughout a two-year period. Observations and training data with older deaf-blind (6-12 years of age) children tend to substantiate these findings.

A majority of younger children with severe visual and auditory impairments who do learn a language system, seem to learn the symbolic language system very slowly. A number of older children seem to reach a ceiling at the prelinguistic level. There is little doubt that those children do present a challenge to those developing intervention programs. Since the children do exhibit a variable group, each of the following questions needs to be addressed for each individual child. Subsequently, we may find that one child may not demonstrate sufficient social skills to produce a symbolic language system. Another child may not demonstrate adequate cognitive skills. Hopefully, continued research from the area of language development will provide additional data so that we have more information concerning possible "prerequisites" or interrelated skills. The research questions presented below are an example of those that are being addressed during the first and second year of the Communication Skills Center project.

1. Have the children obtained the necessary "threshold criteria" of tool use, imitation and play?
2. Have the children expressed sufficient quality and quantity of prelinguistic behaviors?
3. Have sufficient levels of comprehension been reached?
4. Do alternate strategies of graduating the concrete object - to the stationary concrete symbol - to the stationary abstract symbol - to a nonstationary abstract symbol system need to be introduced prior to initiating a symbolic communication system, or
5. Are additional social skills and interactions necessary before a symbolic communication system can be acquired?
6. Are other language modalities more appropriate than the visual-gesture (sign) system?
7. Is the environment responding to the child's current communication system and providing opportunities for higher levels?
8. Is the environment providing sufficient opportunities for communication and language initiation and responses?

Research studies currently are being designed to attempt to answer these questions in a systematic fashion. In addition to investigating the child's productive communication and language system, future studies also need to address the interaction patterns of the primary language communication models and the deaf-blind child's responses to the language of others. Children without sensory impairments are able to comprehend the communication intent of others through nonlinguistic behaviors (gestures, facial expressions, contextual cues) and intonation patterns. If some deaf-blind children are unable to perceive these visual and auditory cues, alternate or unconventional signals may need to be developed. Often deaf-blind children are presented with frequent and high intensity levels of physical guidance or assistance. Many of the children with sensory impairments seem to rely on the physical assistance or prompts without initiating any interactions within their social or physical environments. Thus, it would seem that it would be difficult for these children to extract meanings from being physically manipulated, since the physical assistance often has little relationship to the task or interaction. Alternate teaching strategies or methods of using more natural environmental input cues need to be examined. For example, ongoing routines, objects associated with these routines, and natural environmental tactile cues can provide the child with cues so that he/she begins to anticipate the next activity within a familiar routine. Our preliminary data indicate that persons interacting with the child often provide few opportunities for communication or do not allow enough time for the child to respond. Caregivers, parents, and teachers may have to provide more touch cues, gesture cues and object association cues so that the child comprehends "what" is being communicated. Four systems, within the receptive complex, that will be investigated are the use of: a) direct environmental cues within routines, b) tactile cues, c) gesture cues, and d) object association cues.

Linguistic Communication Development

While the language development literature provides us with new sources of information to be used for interventions, McLean and Snyder-McLean (1978) point out that limited sources of data exist regarding social, cognitive, and pragmatic development as they relate to handicapped children in general. Even though major advances of language intervention for handicapped children have been made with nonvocal augmentative systems (Harris-Vanderheiden & Vanderheiden, 1976; Stremel-Campbell, Cantrell, Halle, 1977; Fristoe & Lloyd, 1978 & 1979), augmentative systems are in no way a panacea for language intervention. The review of communication programs for the severely handicapped by Musselwhite and St. Louis (1982) and the communication guide (Kates & Schein, 1983) for deaf-blind persons provide excellent resources for vocal and nonvocal communication programming strategies and the numerous augmentative systems that are available. Various procedures for helping evaluators and trainers make decisions concerning the use and type of vocal and nonvocal systems are available (Alpert, 1980; Chapman & Miller, 1980; Shane & Bashir, 1980; Silverman, 1980). The implications of the decision-making criteria for use with deaf-blind children have not been established clearly. Additionally, many of the guides and references that are available target early sensory stimulation and then language, omitting the critical prelanguage phases of intervention.

Lloyd (1980) has published a bibliography list of approximately 400 journal articles, chapters, and programs specific to implementing augmentative communication systems. This abundance of literature demonstrates that great strides have been made in the development and implementation of various types of augmentative systems for individuals who are severely handicapped and nonvocal (Musselwhite & St. Louis, 1982; Rabush, Lloyd, & Gerders, 1982; Schiefelbusch, 1980; Vanderheiden & Harris-Vanderheiden, 1976) and for deaf-blind individuals (Teletouch; adapted Canon communicator; Cued speech, Cornett, 1975; Tadoma Method, Norton, 1977; Jensema, 1979). Nevertheless, there is a need to determine more adequate criteria for the selection and more precise evaluation of the effectiveness of nonvocal augmentative systems. Also, it would seem that the child's quality and quantity of prelanguage communication may serve as an important variable in determining if the child is communicating at a level that indicates that the development of a symbolic language system is feasible.

Recent technological advances in the development of augmentative communication devices and systems have offered new options for the multi-handicapped, nonspeaking population. In addition, augmentative communication systems have been developed, and/or applied differently, to affect communication with many severely handicapped persons for whom speech has not been the primary means of expression. The combined use of the communication techniques and symbol systems has been found to be effective in augmenting residual speech skills in some children and/or providing communication access for other children. Attention to the needs of nonspeaking multi-handicapped persons has grown so rapidly that the "consumer market" and client population is currently overwhelmed with the variety of aided and unaided techniques and program options available, but with the lack of substantive information regarding the use, applicability, and effectiveness of each. As a result, service delivery programs are being implemented in an unorganized fashion and many children's needs are not being met or are being met in an inappropriate manner. The University of Wisconsin will be addressing questions in the area of language modalities and augmentative systems during the third year of the project.

Summary and Conclusions

The project review emphasizes the complexity and scope of both the issues and problems associated with the development of communciation interventions with the deaf-blind population. Yet, they also offer hope for their intergration into a systematic and effective intervention process.

In summary the overall review of prelanguage and emergent language indicates that two major questions need to be addressed: a) How is the child with visual and hearing impairments currently communicating, in terms of diversity and frequency, and b) How are important persons within the child's environment communicating with the child? Current models and research of communication and language development indicate that components other than a productive language system need to be addressed. Early affective behaviors in mother-child interactions seem to be extremely important prior to the child's use of an intentional communication system. The child's primary communication model (mother/caregiver) must respond initially to the child's early behaviors as if they were communicative. Therefore, early intervention programs may focus at changing the behavior and interaction patterns of the primary language models rather than targeting solely the child's behavior. Continued assessment of the child's sensory systems is necessary in order to determine what environmental adaptations may be necessary so that the child can respond to the mother's input. Consequently, early behaviors and reciprocal interactions within natural routines need to be assessed and programmed prior to targeting a prelanguage communication system (as discussed by Siegal-Causey and Guess).

From the literature that was discussed it may be seen that children use frequent and diverse prelanguage communication prior to learning a symbolic language system. The communication system gradually becomes more intentional and children are able to express a variety of different intents (requesting object, requesting action, protesting, requesting attention) before saying their first word. In all likelihood, it will be necessary to determine what type of adaptations will need to be made if the deaf-blind child is unable to use a communicative point or an early communicative vocalization due to sensory or motor impairments. Additionally, the object use, play skills, imitation skills, and tool use skills of each child need to be examined to determine how the deaf-blind child is interacting with his physical environment. The social turn-taking skills involved in prelanguage communication also need to be addressed to determine if the child is recognizing the listener as an agent to get something done for him/her. The child's comprehension or recognition of the prelanguage acts/behaviors from other persons is also a critical aspect. The child must utilize nonverbal environmental features in order to learn the meaning of the linguistic symbols or concepts directed to him. The quantity and quality of communication and opportunities from other persons (parents, teachers, siblings, and peers) also needs to be addressed.

The topic of the selection of augmentative language systems will not be addressed in detail until the third year of the project. Nevertheless, the perspectives of individual differences, distancing the symbol from the referent, and selecting first words are important as the deaf-blind child is learning to use concrete symbols in play and in communication. The process of using concrete objects and gradually introducing more abstract symbols (in abstract, stationary systems or in gesture-signs systems) is critical to the development of both prelanguage and language intervention programs. Both imitation and recognition (comprehension) of symbols seem to be important constructs in training symbolic behavior.

The existing knowledge and interventions for deaf-blind children have not typically described the quantitative similarities and differences that exist on a normal developmental continuum. Although it is recognized that the child with deafness and blindness may indeed require interventions that differ from the normal development sequence, there is a need to: a) continually examine how normal children develop communication skills, b) examine the efficacy of current intervention practices, c) adapt sequences of normal developmental progression and current practices for children who are sensory impaired, and d) evaluate the effectiveness of the sequence of skills being trained, the content and context of "what" is trained, and the procedures used to train these skills. Only then can we further evaluate the effectiveness of broader intervention systems for children who are sensory impaired.

SHH1

References

Alpert, C. (1980). Procedures for determining the optimal nonspeech mode with the autistic child. In R. L. Schiefelbusch (Ed.), Nonspeech language and communication: Analysis and intervention (pp. 389-420). Baltimore, MD: University Park Press.

Bates, E. (1976). Lanuage and context: The acquisition of pragmatics. New York: Academic Press.

Bates, E. (1979a). Intentions, conventions, and symbols. In E. Bates, L. Benigni, I. Bretherton, L. Camaioni, & V. Volterra (Eds.), The emergence of symbols: Cognition and communication in infancy (pp. 33-42). New York: Academic Press.

Bates, E. (1979b). The biology of symbols: Some concluding thoughts. In E. Bates, L. Benigni, I. Bretherton, L. Camaioni, and V. Volterra (Eds.), The emergence of symbols: Cognition and communication in infancy (pp. 315-382). New York: Academic Press.

Bates, E., Benigni, L., Bretherton, I. and Camaioni, L., & Volterra, V. (1977). From gesture to the first word: On cognitive and social prerequisites. In M. Lewis & L. A. Rosenblum (Eds.), Interaction, conversation and the development of language (pp. 247-307). New York: John Wiley.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979a). Cognition and communication from nine to thirteen months: Correlational findings. In E. Bates, L. Benigni, I. Bretherton, L. Camaioni, & V. Volterra (Eds.), The emergence of symbols: Cognition and communication in infancy (pp. 69-140). New York: Academic Press.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979b). The emergence of symbols: Cognition and communication in infancy. New York: Academic Press.

Bates, E., Camaioni, L., & Volterra, V. (1975). The acquisition of performatives prior to speech. Merrill-Palmer Quarterly, 21, 205-226.

Bernard-Opitz, V. (1982). Pragmatic analysis of the communicative behavior of an autistic child. Journal of Speech and Hearing Disorders, 47(1), 99-109.

Bloom, L. (1970). Language development: Form and function in emerging grammars. Cambridge: M.I.T. Press.

Bloom, L. (1973). One word at a time: The use of single-word utterances before syntax. The Hague: Mouton.

Bloom, L., Hood, L., & Lightbrown, P. (1974). Imitation in language development: If, when, and why. Cognitive Psychology, 6, 380-420.

Bloom, L., & Lahey, M. (1978). Language development and language disorders. New York: John Wiley & Sons, Inc.

Bonvillian, J. D., & Nelson, K. E. (1978). Development of sign language in autistic children and other language-handicapped individuals. In P. Siple (Ed.), Understanding language through sign language research. New York: Academic Press.

Bonvillian, J. D., & Orlansky, M. D. (1984). Sign language acquistion: Early steps. Communication Outlook, 6(1), 10-12.

Bonvillian, J. D., Orlansky, M. D., & Novack, L. L. (1983). Development milestones: Sign language acquisition and motor development. Journal of Child Language, 54, 135-145.

Bonvillian, J. D., Orlansky, M. D., Novack, L. L., & Folven, R. J. (1983). Early sign language acquisition and cognitive development. In D. Rogers & J. A. Sloboda (Ed.), The acquisition of symbolic skills. Chicago: Plenum Press.

Bowerman, M. (1973). Early syntactic development: A cross linguistic study with special reference to Finnish. London: Cambridge University Press.

Brazelton, T. B., Koslowski, B., & Main, M. (1974). The origins of reciprocity: The early mother-infant interaction. In M. Lewis & L. A. Rosenblum (Eds.), The effect of the infant on its caregiver. New York: Wiley.

Bretherton, I., Bates, E., McNew, S., Shore, C., Williamson, C., & Beeghly-Smith, M. (1981). Comprehension and production of symbols in infancy: An experimental study. Developmental Psychology, 17(6), 728-736.

Bricker, D., & Carlson, L. (1981). Issues in early language intervention. In R. Schiefelbusch & D. Bricker (Eds.), Early language: Acquisition and intervention. Baltimore, MD: University Park Press.

Brown, R. (1973). A first language: The early stages. Cambridge: Harvard University Press.

Brown, R. (1977). Why are signed languages easier to learn than spoken languages? Paper presented at the National Symposium on Sign Language Research and Teaching, Chicago.

Brown, R., & Bellugi, U. (1964). Three processes in the child's acquisition of syntax. Harvard Educational Review, 34, 133-151.

Bruner, J. S. (1974). The organization of early skilled action. In M. P. M. Richards (Ed.), The integration of the child into a social world. London: Cambridge University Press.

Bruner, J. S. (1975a). The ontogenesis of speech acts. Journal of Child Language, 2, 1-19.

Bruner, J. (1975b). From communication to language: A psychological perspective. Cognition, 3, 255-287.

Bruner, J. S. (1977). Early social interaction and language acquisition. In H. R. Schaffer (Ed.), Studies in mother-infant interaction (pp. 271-289). New York: Academic Press.

Bruner, J. S., Roy, C., & Ratner, N. (1978). The beginnings of request. In K. E. Nelson (Ed.), Children's language: Vol. 1., New York: Gardner Press.

Carter, A. (1975). The transformation of sensorimotor morphemes into words: A case study of the development of "more" and "mine." Journal of Child Language, 2(2), 233-250.

Chapman, R. (1981). Exploring intentional communication. In J. Miller (Ed.), Assessing language production in children. Baltimore: University Park Press.

Chapman, R. S., & Miller, J. F. (1980). Analyzing language and communication in the child. In R. L. Schiefelbusch (Ed.), Nonspeech language and communication: analysis and intervention (pp. 159-96). Baltimore: University Park Press.

Cirrin, F. M., & Rowland, C. M. (in press). Communicative assessment of nonverbal youths with several profound mental retardation. Mental Retardation.

Chomsky, N. (1957). Syntactic structures. The Hague: Mouton.

Clark, P. (1977). What's the use of imitation? Journal of Child Language. 1, 341-358.

Coggins, T. (1979). Relational meaning encoded in the two-word utterances of stage I Down's syndrome children. Journal of Speech and Hearing Research, 22, 166-178.

Coggins, T., Carpenter, R., & Mastergeorge, A. (1981, November). Performative acquisition in children eight to fifteen months of age. Paper presented at American Speech-Language-Hearing Association Convention, Los Angeles.

Coggins, T. E., Carpenter, R. L., Owings, N. O. (1983). Examining early intentional communication in Down's syndrome and nonretarded children. British Journal of Disorders of Communication, 18(2), 98-106.

Cornett, R. O. (1975). Cued speech and oralism: An analysis. Audiological Hearing Education, 1, 26-33.

Corsaro, W. A. (1981, December). The development of social cognition in preschool children: Implications for language learning. Topics in Language Disorders, 77-95.

Cromer, R. F. (1974). The development of language and cognition: The cognition hypothesis. In B. Foss (Ed.), New perspectives in child development (pp. 184-252). Harmondsworth, Middlesex: Penguin Books, Ltd.

Cromer, R. F. (1979). The strengths of the weak form of the cognition hypothesis for language acquisition. In V. Lee (Ed.), Language development (pp. 102-130). Croom Helm: London.

Cromer, R. F. (1981). Reconceptualizing language acquistion and cognitive development. In R. L. Schiefelbusch and D. Bricker (Eds.), Early language: Acquistion and intervention (pp. 51-138). Baltimore: University Park Press.

Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. Journal of Autism and Childhood Schizophrenia, 3, 281-292.

Curtis, W. S. (1975, May). Learning behavior of deaf-blind children. Education of the Visually Handicapped, 7(2), 40-48.

Curtis, S., Doulon, E. T., & Wagner, E. (1970). Deaf-blind children: A program for evaluating their multiple handicaps. New York: American Foundation for the Blind.

Curtis, S., Prutting, C., & Lowell, G. (1979). Pragmatic and semantic development in young children with impaired hearing. Journal of Speech and Hearing Research, 23, 534-553.

Dale, P. (1976). Language development. New York: Holt, Rinehard and Winston.

Dinsmore, A. B. (1959). Methods of communication with deaf-blind people. New York: American Foundation for the Blind. William Byrd Press.

Dore, J. (1974). A pragmatic description of early language development. Journal of Psycholinguistic Research, 4, 343-351.

Dore, J. (1975). Holophrases, speech acts and language universal. Journal of Child Language, 2, 21-40.

Ervin-Tripp, S. M. (1973). Language acquistion: A communicative choice. Palo Alto, CA: Stanford University Press.

Fey, M., Leonard, L., Fey, S., & O'Connor, K. (1978, October). The intent to communicate in language-impaired children. Paper presented at the Boston University Conference on Language Development.

Folger, J. P., & Chapmen, R. S. (1978). A pragmatic analysis of spontaneous imitations. Journal of Child Language, 5, 25-38.

Fraiberg, S. (1971). Smiling and stranger reaction in blind infants. In J. Hellmuth (Ed.), The exceptional infant (pp. 110-127). New York: Brunner/Mazel.

Frailberg, S. (1974). Blind infants and their mothers: An examination of the sign system. In M. Lewis & L. Rosenblum (Eds.), The effect of the infant on its caregiver (pp. 215-232). New York: Wiley.

Fraiberg, S. (1977). Insights from the blind: Comparative studies of blind and sighted babies. New York: Basic Books.

Freedle, R., & Lewis, M. (1977). Prelinguistic conversation. In M. Lewis, & L. A. Rosenblum (Eds.), Interaction, conversation, and the development of language. New York: Wiley.

Fristoe, M., & Lloyd, L. L. (1978). A survey of the use of non-speech communication systems with the severely communication impaired. Mental Retardation, 16, 99-101.

Fristoe, M., & Lloyd, L. L. (1979). Signs used in manual communication training with persons having severe communication impairments. American Association of the Education of Severely/Profoundly Handicapped, Review 4, 364-73.

Greenfield, P., & Smith, J. (1976). The structure of communciation in early development. New York: Academic Press.

Greenwald, C. A., & Leonard, L. B. (1979). Communicative and sensorimotor development of Down's syndrome children. American Journal of Mental Deficiency, 84, 296-303.

Halliday, M. (1975). Learning how to mean. In E. Lenneberg & Lenneberg (Eds.), Foundations of language development: A multidisciplinary approach, Vol. 1, New York: Academic Press.

Holland, A. (1975). Language therapy for children: Some thoughts on context and content. Journal of Speech and Hearing Disorders, 40, 514-523.

Ingram, D. (1972). Transitivity in child language. Language, 47, 888-910.

Ingram, D. (1981). The transition from early symbols to syntax. In R. L. Schiefelbusch and D. Bricker (Eds.), Early language: acquisition and intervention (pp. 259-286). Baltimore: University Park Press.

Jensema, C. K. (1979). Communication methods used with deaf-blind children: Making the decision. American Annals of the Deaf, 124, 7-8.

Jensema, C. K. (1981). Report of communication method usage by teachers of deaf-blind children. American Annals of the Deaf, 126(5), 488-491.

Kagan, T. (1976). Emergent themes in human development. American Scientist, 64, 186-196.

Kahn, J. V. (1975). Relationship of Piaget's sensorimotor period to language acquistion of profoundly retarded children. American Journal of Mental Deficiency, 79, 640-643.

Karlan, G. R., & Lloyd, L. L. (1983). Considerations in the planning of communication intervention: Selecting a lexicon. Journal of the Association of the Severely Handicapped, 8, 13-25.

Kates, L., & Schein, J. D. (1980). A complete guide to communication with deaf blind persons. Silver Springs, MD: National Association of the Deaf.

Kates, L., & Schein, J. A. (1983). Complete guide to communication with deaf-blind persons. Silver Springs, MD: National Association of the Deaf.

Kennedy, A. E. (1974). Language awareness and the deaf-blind child. Teaching Exceptional Children, 6(2), 99-102.

Kramer, L., & Rosenfeld, J. (1975). Speech communication techniques with the adult deaf-blind. Journal of Rehabilitation of the Deaf, 8(4), 27-34.

Lahey, M., & Bloom, L. (1977). Planning a first lexicon: Which words to teach first. Journal of Speech and Hearing Disorders, 42, 340-350.

Leonard, L. B. (1972). What is deviant language? Journal of Speech and Hearing Disorders, 37, 427-447.

Leonard, L. B. (1975). The role of nonlinguistic stimuli and semantic relations in children's acquisition of grammatical utterances. Journal of Experimental Child Psychology, 19, 346-357.

Leonard, L. B., Camarata, S., Rowan, L. E., & Chapman, K. (1982). The communicative functions of lexical usage by language impaired children. Applied Psycholinguistics, 3, 109-125.

Lewis, M., Brooks, J., & Haviland, J. (1978). Hearts and faces: A study in the measurement of emotion. In M. Lewis & L. Rosenblum (Eds.), The development of affect. New York: Plenum Pulbishing Corp.

Lewis, M., & Freedle, R. (1973). Mother-infant dyad: The cradle of meaning. In P. Pliner, L. Krames & T. Alloway (Eds.), Communication and affect: Language and thought. New York: Academic Press.

Lloyd, L. L. (1980). Unaided nonspeech communication for severely handicapped individuals: An extensive bibliography. Education and Training of the Mentally Retarded, 15(1), 15-34.

Lobato, D., Barrera, R. D., Feldman, R. S. (1981). Sensorimotor functioning and prelinguistic communication of severely and profoundly retarded individuals. American Journal of Mental Deficiency, 85(5), 489-496.

Lock, A. (1978). Action, gesture and symbol: The emergence of language. New York: Academic Press.

Mahoney, G. (1975). Ethological approach to delayed language acquistion. American Journal of Mental Deficiency, 80(2), 138-148.

Mahoney, G., Glover, A., & Finger, I. (1981). Relationship between language and sensorimotor development of Down syndrome and nonretarded children. American Journal of Mental Deficiency, 86(1), 21-28.

Marshall, N., Hegrenes, J., & Goldstein, S. (1973). Verbal interactions: Mothers and their retarded children versus mothers and their nonretarded children. American Journal of Mental Deficiency, 77, 415-419.

Masur, E. F. (1981). Mothers' responses to infants' object-related gestures: Influences on lexical development. Journal of Child Language, 9, 23-30.

Messer, D. (1978). The intergration of mother's referential speech with joint play. Child Development, 49, 781-787.

McCormick, L. (1984). Perspectives on categorization and intervention. In L. McCormick & R. L. Schiefelbusch (Eds.), Early language intervention (pp. 89-116). Columbus, OH: Charles E. Merrill.

McLean, J. E., & Snyder-McLean, L. K. (1978). Transactional approach to early language training. Columbus, OH: Charles E. Merrill.

Menyuk, P. (1964). Comparison of grammar of children with functionally deviant and normal speech. Journal of Speech and Hearing Research, 7, 109-121.

Miller, J. F. (1981). Early psycholinguistic acquisition. In R. L. Schiefelbusch & D. Bricker (Eds.), Early language: Acquistion and intervention (pp. 329-338). Baltimore: University Park Press.

Miller, J. F., Chapman, R., Branston, M., & Reichle, J. (1980). Language comprehension in sensorimotor stages 5 and 6. Journal of Speech and Hearing Research, 23, 243-260.

Miller, J. F., & Yoder, D. (1974). An ontogenetic language teaching strategy for retarded children. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives--acquisition, retardation and intervention* (pp. 505-528). Baltimore, MD: University Park Press.

Moerk, E. (1975). Verbal interactions between children and their mothers during the preschool years. *Developmental Psychology*, *11*, 788-794.

Moerk, E. (1977). *Pragmatic and semantic aspects of early language development*. Baltimore: University Park Press.

Moores, D. F. (1977). *Educating the deaf: Psychology, principles, and practices*. Boston: Houghton-Mifflin.

Murphy, C. M., & Messer, D. J. (1977). Mothers, infants and pointing: A study of gesture. In H. R. Schaffer (Ed.), *Studies in mother-infant interaction*. London: Academic Press.

Musselwhite, C. R., & St. Louis, K. W. (1982). *Communication programming for the severely handicapped: Vocal & nonvocal strategies*. Houston: College-Hill Press.

National Association of State Directors of Special Education, Inc. (1982). *SEA Deaf-Blind Definitions*. 2021, K Street, N. W., Suite 315, Washington, D.C., 20006.

Nelson, K. (1973). Structure and strategy in learning to talk. *Monograph of the Society for Research in Child Development*, *38*(1-2, Serial No. 149).

Nelson, K. (1974). Concept, word, and sentence. *Interrelations in acquisition and development*. *Psychological Review*, *81*, 267-85.

Nelson, K. (1977). First steps in language acquistion. *Journal of the American Academy of Child Psychiatry*, *16*(4), 563-583.

Nelson, K. (1978). Early speech in its communicative context. In F. Minifie & L. Lloyd (Eds.), *Communicative and cognitive abilities--early behavioral assessment*. Baltimore, MD: University Park Press.

Nelson, K. (1981). Individual differences in language development: Implications for development and language. *Developmental Psychology*, *17*(2), 170-187.

Newport, E., & Ashbrook, E. J. (1977). The emergence of semantic relations in A.S.L. *Papers and Reports in Child Language*, *13*, 16-21.

Ninio, A., & Bruner, J. (1978). The achievement and antecedents of labelling. *Journal of Child Language*, *5*, 1-15.

Norton, S. J., Schultz, M. C., Reed, C. M., Braida, L. D., Durlach, N. I., Rabinowitz, W. M., & Chomsky, C. (1977). Analytic study of the Tadoma method: Background & preliminary results. *Journal of Speech and Hearing Research*, *20*, 574-595.

Owens, R., & McDonald, J. (1982). Communicative uses of the early speech of nondelayed and Down syndrome children. *American Journal of Mental Deficiency*, *86*(5), 503-510.

Peters, A. M. (1977). Language learning strategies: Does the whole equal the sum of the parts. *Language*, *53*, 560-573.

Piaget, J. (1962). *Play, dreams and imitation*. New York: W. W. Norton and Company.

Prinz, P., & Prinz, E. (1979, April). *Acquisition of ASL and spoken English in a hearing child of a deaf mother and hearing father*. Paper presented at the Stanford Child Language Research Forum, Stanford University.

Prizant, B., & Duchan, J. (1981). The functions of immediate echolalia in autistic children. *Journal of Speech and Hearing Disorders*, *46*, 241-250.

Prizant, B., & Rydell, P. (1981, November). *A functional analysis of delayed echolalia of autistic children*. Paper presented at the annual meeting of the American Speech-Language-Hearing Association, Los Angeles.

Rabush, D. R., Lloyd, L. L., & Gerdes, M. (1982, November). Aided nonspeech communication: An extensive bibliography. *Communication Outlook*, Michigan State University.

Rees, N., Kruger, F., Bernstein, D., Kramer, L., & Bezas, M. (1974). The acquisition of a first language in a blind-deaf adult: A case study of a language development in an adult with a history of deaf-blindness. *Journal of Rehabilitation of the Deaf*, *8*(2), 11-23.

Rogow, S. M. (1980). Language development in blind multihandicapped children: A model of co-active intervention. *Child: Care, Health, Development*, *6*, 301-308.

Rondal, J. (1978). Maternal speech to normal and Down's syndrome children matched for mean length of utterance. In C. Meyers (Ed.), *Quality of life in severely and profoundly retarded people: Research foundations for improvement*. Washington, D. C.: American Association on Mental Deficiency.

Rowan, L., & Leonard, L. (1981, November). *Performance and presuppositional skills in language disordered and normal children*. Paper presented to American Speech-Language-Hearing Association, Los Angeles.

Rowland, C. (1984a). Preverbal communication of blind infants and their mothers. *Journal of Visual Impairment & Blindness*, 297-302.

Rowland, C. (1984b). *Communication matrix*. Unpublished assessment. Monmouth, OR: Teaching Research.

Ryan, J. (1974). Early language development. In M. P. M. Richards (Ed.), *The integration of the child into a soical world*. Cambridge: Cambridge Press.

Ryan, J. (1975). Mental subnormality and language development. In G. Lenneberg & E. Lenneberg (Eds.), *Foundations of language development*. New York: Academic Press.

Schaffer, H. R. (1977). *Studies in mother-infant interaction*. London: Academic Press.

Schiefelbusch, R. L. (1980). *Nonspeech language & communication: Analysis & intervention*. Baltimore: University Park Press.

Schlesinger, H. S. & Meadows, K. P. (1972). *Sound and sign*. Berkeley: University of California Press.

Schuler, A. (1979). Echolalia: Issues and clinical applications. Journal of Speech and Hearing Disorders, 44, 411-434.

Shane, H. C., & Bashir, A. S. (1980). Election criteria for the adoption of an augmentative communication system: Preliminary considerations. Journal of Speech and Hearing Disorders, 45, 408-414.

Sherrod, K., Crawley, S., Petersen, G., & Bennett, P. (1978). Maternal language to prelinguistic infants: Semantic aspects Infants Behavior and Development, 1, 335-345.

Shields, J. G. (1972). Methods for teaching deaf children with visual differences. Teacher of the Deaf, 70, 370-373.

Silverman, F. (1980). Communication for the speechless. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Skinner, B. F. (1957). Verbal behavior. New York: Appleton-Century Crofts.

Slobin, D. T. (1970). Universals in grammatical development in children. In G. B. Flores d' Arcais and W. J. M. Levett (Eds.), Advances in psycholinguistics. New York: Americal Elsevier.

Slobin, D. T. (1973). Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. T. Slobin (Eds.), Studies of child language development. New York: Holt, Rinehart & Winston, Inc.

Snyder, L. (1975). Pragmatics in language-deficient children: Prelinguistic and early verbal performatives and presuppositions. Unpublished doctoral dissertation, University of Colorado.

Snyder, L. S. (1978). Communicative and cognitive abilities and disabilities in the sensorimotor period. Merrill-Palmer Quarterly, 24, 161-180.

Snyder, L. S., & Yoshinaga, C. (1982). Indices of progress in deaf-blind children: Final report. Denver, CO: University of Denver.

Stein, L. K. (1982). Characteristics of a young deaf-blind population. American Annuals of the Deaf, 127(7), 828-837.

Stevenson, M. B., & Lamb, M. E. (1981). The effects of social experience. In M. E. Lamb (Ed.), Infant social cognition: Theoretical and empirical considerations (pp. 375-394). Hillside: Erlbaum.

Stillman, R. (Ed.). (1978). The Callier-Azusa Scale. Dallas, TX: The South Central Regional Center for Services to Deaf-Blind Children, Callier Center for Services of Deaf-Blind Children.

Stremel-Campbell, K., Cantrell, D., & Halle, J. (1977). Manual signing as a language system and as a speech initiator for the nonverbal severely handicapped student. In E. Sontag (Ed.), Educational programming for the severely and profoundly handicapped (pp. 335-47). Reston, VA: Council for Exceptional Children, Division on Mental Retardation.

Stremel-Campbell, K., Clark-Guida, J., & Johnson-Dorn, N. (1984). Communication placement assessment. Monmouth, OR: Teaching Research Publications.

Stremel-Campbell, K., Johnson-Dorn, N., Clark-Guida, J., & Udell, T. (1984). Communication curriculum. Monmouth, OR: Teaching Research Publications.

Sugarman, S. A. (1973). A description of communicative development in the prelanguage child. Honors thesis, Hampshire College.

Sugarman, S. A. (1977). A description of communciative development in the prelanguage child. In I. Markova (Ed.), The social context of language. London: John Wiley & Sons.

Taylor, J. J., & Achenbach, T. M. (1975). Moral and cognitive development in retarded and nonretarded children. American Journal of Mental Deficiency, 80, 43-50.

Thoman, E. (1981). Affective communication as the prelude and context for language learning. In R. Schiefelbusch & D. Bricker (Eds.), Early language: Acquisition and intervention. Baltimore, MD: University Park Press.

Uzgiris, I. (1981). Experience in a social context. In R. L. Schiefelbusch & D. Bricker (Eds.), Early language: Acquisition and intervention (pp. 139-168). Baltimore: University Park Press.

Urwin, C. (1975). The development of a blind baby. Unpublished manuscript, Cambridge University.

Vanderheiden, G. C., & Harris-Vanderheiden, D. (1976). Communication techniques and aids for the non-vocal, severely handicapped. In L. L. Lloyd (Ed.), Communication assessment and intevention strategies. Baltimore, MD: University Park Press.

van Dijk, J. (1967). The non-verbal deaf-blind child and his world: His outgrowth towards the world of symbols. Holland: Institute for the Deaf.

Volterra, V., Bates, E., Benigni, L., Bretherton, I., & Camaioni, L. (1979). First words in language and action: A qualitative look. In E. Bates, L. Benigni, I. Bretherton, L. Camaioni, and V. Volterra (Eds.), The emergence symbols: Cognition and communication in infancy (pp. 141-222). New York: Academic Press.

Warren, D. (1977). Blindness and early childhood development. New York: American Foundation for the Blind, Inc.

Weisz, J. R., & Yeates, K. O. (1981). Cognitive development in retarded and nonretarded persons: Piagetian tests of the similar structure hypothesis. Psychological Bulletin, 90(1), 153-178.

Werner, H., & Kaplan, B. (1963). Symbol formation. New York: Wiley.

Wetherby, A. M., & Prutting, C. A. (1984). Profiles of communicative, cognitive, and social abilities in autistic children. Journal of Speech & Hearing Research, 27, 364-377.

Wilbur, R. B. (1976). The linguistics of manual languages and manual systems. In L. L. Lloyd (Ed.), Communication assessment and intervention strategies. Baltimore: University Park Press.

Wilbur, R. (1979). American sign language and sign language systems. Baltimore: University Park Press.

Yarnall, G. D. (1980). Preferred methods of communication of four deaf-blind adults. Journal of Rehabilitation of the Deaf, 13(3), 1-8.

Zigler, E. (1967). Familial mental retardation: A continuing dilemma. Science, 155, 292-298.

Zigler, E. (1969). Developmental versus difference theories of mental retardation and the problem of motivation. American Journal of Mental Deficiency, 73, 536-556.

DT60

Z5346
B875
C737

Bullis, Michael (ed.)
Communication development
in young children with
deaf-blindness :

Z5346
B875
C737

Bullis, Michael (ed.)
Communication
development in young
children with

TITLE

DATE DUE	BORROWER'S NAME
	reference

REFERENCE COPY
DO NOT REMOVE FROM THE LIBRARY

AMERICAN FOUNDATION FOR THE BLIND, INC.
15 WEST 16th STREET
NEW YORK, N. Y. 10011

DEMCO